THE

ELECTRICAL REVIEW.

VOL. LI. AUGUST 29, 1902. No. 1,292.

"ELECTRICAL REVIEW."

Vol. LI.] CONTENTS: August 29th, 1902. [No. 1,292.

	Page
English and American Engines for the Glasgow Tramways ...	329
Signalling for Railway Tunnel Working	331
Vibrating Cable Relay (*illustrated*) (*concluded*)...	332
Refuse Destruction: Its Sanitary and Steam-Raising Aspects (*continued*)	334
Re Earthing the Middle Wire in Three-Wire Distributing Systems...	336
The Internal Combustion Engine	337
Distribution with Uninsulated Neutral	338
A European Electrical Combine	338
Correspondence:—	
Re South Shields Accounts	339
The Earthing of the Middle Conductor	340
Earthing	340
Railway Signals	340
Wireless Telegraphy	341
Our Legal Query Column	341
Business Notes	341
Electricity at the Covent Garden Opera House (*illustrated*) ...	347
Electrical Plant at the Düsseldorf Exhibition (*illustrated*) (*continued*)	350
Traffic Receipts	358
Stocks and Shares	358
Share List of Electrical Companies	359
Market Quotations	360
The Marconi Station at Cape Breton (*illustrated*)	361
Pacific Cable Survey	361
The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders (*illustrated*) (*concluded*)	363
On Some Phenomena Affecting the Transmission of Electric Waves over the Surface of the Sea and Earth (*illustrated*) (*concluded*)	365
The Ideal Electrical Engineering Course	366
New Patents...	367
Abstracts of Published Specifications	368

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone No. 988 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 23, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

ENGLISH AND AMERICAN ENGINES FOR THE GLASGOW TRAMWAYS.

A FEW weeks ago there appeared in the advertisement pages of certain American journals a highly laudatory account of the Allis engines in the Glasgow tramway power station. The advertisement was inserted by the Allis Company, of Milwaukee, who made the engines, and was in the form of a letter said to have been written to the Allis Company by a London consulting engineer, Mr. H. F. Parshall. His name was attached to the letter, and we have no reason to doubt its authenticity. American journals greedily seized on this as an opportunity to praise American steam engines, and commented on it in a way that would convey to the ordinary reader that Mr. Parshall was an English engineer so proud of these American engines that he must needs go out of his profitable way to write this letter to the American engine-makers. Most of our readers, of course, know that Mr. Parshall is not an Englishman, but is an American engineer who was engaged by the Glasgow Corporation to do the best he could for his clients, and that he recommended them to order the four big engines from Messrs. Allis at a cost of some £20,000 above the price offered by Messrs. Hick, Hargreaves & Co., of Bolton [ELEC. REV., August 25th, 1899, p. 331].

This advice was subsequently modified; but Mr. Parshall succeeded in inducing the Corporation to buy four clumsy over-heavy engines made on plans that were practically "Allis" all over. (See ELECTRICAL REVIEW, September 1st, 1899, p. 344.) We thought then, and we think still, that these engines were designed under that now exploded bogey of terrible stress, which for so long was used by Americans as a stalking horse to get orders for American engines, supposed to be designed to meet such awful stresses, but in reality in no way superior to engines of English design. The hubbub raised about the whole business at the time had such effect, that, since that period, excepting under more or less similar American influences, no large engines, and but few small ones, have come from America to this country. The final upshot at Glasgow was that two of the engines were allotted to Messrs. Musgrave, of Bolton, to build, and two went to the Allis Company, of America.

We do not know how many large engines had previously been built by Messrs. Musgrave, but Messrs. Hick, Hargreaves and Co. had built much larger engines for India; after all, the Glasgow engines were only of 4,000 H.P.

The current number of *Engineering*, a so-called English journal of ultra-trans-Atlantic views, publishes an account of the trials made by Prof. Barr of the whole of the Glasgow engines. Our contemporary's article is really a piece of special pleading for Mr. Parshall and

the Allis engines, and draws particular attention to the mechanical efficiency of the Allis engine, which is said to have been found by Prof. Barr to be 96 per cent., or $\frac{\text{B.H.P.}}{\text{I.H.P.}} = 0{\cdot}96$. We quite agree with our contemporary that this is "extraordinary," and we can smile at our contemporary's bolstering up of the closely inferential method adopted by Prof. Barr to find the B.H.P., and the elementary explanation of the methods to be followed in order to "infer." The steam consumption was 12·2 lbs. per B.H.P.-hour [? I.H.P.-hour], and we again agree that it was a "really marvellous performance" for the class of engine.

The overall efficiency of the same engines and generators, $\frac{\text{E.H.P.}}{\text{I.H.P.}}$, was found to be 92 per cent. Be it noted that the whole value of this efficiency test is based upon the ratio of E.H.P. to I.H.P., from which the ratio of B.H.P. to I.H.P. may be deduced. There is little probability of serious error having been made in the measurement of the I.H.P., but this is far from true of the E.H.P. The alternators generate three-phase current at 6,500 volts; how were the current and pressure measured, and above all, *how was the power factor ascertained?* Any inaccuracy in the latter measurement—never an easy one—will be reflected in the efficiency ratio.

Our contemporary has a good swallow, but unfortunately goes to the trouble in this article to refer twice to certain preliminary difficulties with the Musgrave engines, and makes absolutely no reference to the more serious preliminary troubles of the American engines. Prof. Barr finds the mechanical efficiency of the English engines to be 96 and 97 per cent., also, we presume, by the inferential method. At part load they are said to have used 13·4 and 13·2 lbs. of steam per I.H.P.-hour, the power being 3,590 and 3,840 H.P. We are not told the power at which the American engines showed the "really marvellous" 12·2 lbs. The over-all efficiency of the sets was 93 per cent.

If Prof. Barr's figures of mechanical efficiency are proportionately wrong in each case, for we certainly do not consider them to be correct for either the English or the American engines, then he has shown that an American firm, building engines to its own designs, has been beaten by an English firm which has been called on to build to a design not its own. The English firm has built an American engine better than the Americans, in fact.

Our contemporary now says that in 1899 it expressed the opinion that "perfectly satisfactory engines could be obtained in this country, but that it was foolish to disregard the teachings of American experience." This inconsistent statement carries its own refutation. The teachings of American experience are, *inter alia*, that the American practice of putting fly-wheels and generators at opposite ends of the crank-shaft is bad. That excessive shaft diameters are employed is simply a relic of the bad practice of Americans as above. They drop the wrong position of the fly-wheel, but cling fast to the huge shaft rendered necessary by that error. Does our contemporary wish to see the bored crosshead-guide repeated in large engines? It is one of those details which we prefer to see confined to its place in small engines. The best our contemporary can say of the Musgrave engines is that they "have been demonstrated to be better than the guarantee." The natural inference to be gathered is that, like the family dunce, they have scraped through with difficulty a task easily taken with flying colours by the American genius. The English engines had no more preliminary difficulties than the American. They are distinctly better engines, notably in respect of framing and guides. We cannot doubt that in a few years they will show that their cylinders are harder by far than those of the Americans.

We are not given details of the tests or loads. Our contemporary's article is, as we state above, simply special pleading for the American engine builders, and it ought to have appeared in the advertisement columns. It is time that British manufacturers roused themselves to more closely consider the methods by which foreign trade is pushed in this country. It appears that the criticism of ourselves by ourselves is worked up by Americans so as to help American trade, and it must be said that if American interests are to be helped, no statement is too bad to publish about British goods, for the American idea of business and of commerce generally is entirely contrary to that held here. The English idea has been that the prosperity of one nation is for the good of all. The American idea is that American prosperity demands that all others should be destroyed. It is a false idea, false economically as well as morally. The whole business of these Glasgow engines has been unfairly treated by the American press, from the very first, when it was so boldly proclaimed that British builders could not build engines for traction work, down to the present time when such a letter as that purporting to be written by Mr. Parshall is published broadcast in America, with no hint of any kind that Mr. Parshall is an American.

Prof. Barr is said to have reported adversely on the smaller engines of Glasgow make, by Messrs. Duncan Stewart & Co. Of the few figures given we would point out that a combined efficiency of 88·3 and 88·5 per cent. and a steam consumption of 15·2 and 15·8 lbs. per B.H.P.-hour are all very much more credible and likely figures for the large engines also, no matter what their nationality. Granting that each engine was run at its economical steady load, the figures published cannot be accepted unless for the Stewart engines. They bear *primâ facie* evidence of some overlooked error.

Will any practical steam engineer agree that a three-cylinder compound engine can be expected to give such results as we are asked to accept from these Glasgow engines?

If the coefficient of friction of a good bearing be taken as 0·05, the friction of the bearings that carry the 220,000 lbs. fly-wheel of the Glasgow engines works out at 209 H.P., the speed being 75 revolutions per minute.

At 3,840 H.P. this amounts to 5½ per cent. Thus this one bearing alone would reduce the mechanical efficiency of the engine to 94½ per cent. But there remain the bearings of the three cranks, with the friction due to the steam load on their respective pistons. There are three crank-pins with a very high velocity of rubbing, three crosshead pins and three crosshead guides with a rubbing velocity greater than the fly-wheel bearing. There is also the friction due to the weight of the armature. The friction of three pistons, the clamping effect of the glands and packing on the piston rods, the friction of 12, by no means small, Corliss valves and

gear and the large eccentrics. The total friction will probably be much in excess of that due to the fly-wheel. Granting an abnormally low coefficient of friction, we cannot see how Prof. Barr can put forth a mechanical efficiency of 97 per cent. It is preposterous to ask engineers to accept such a figure. Even were the coefficient of friction allowed to be only 0 01, the one bearing would account for 1·1 per cent., and there would still be all the others enumerated. The question may be asked, has Prof. Barr taken diagrams from these engines and shown that unloaded they turn round with a friction diagram of 115 I.H.P., because even this figure, which is imperative, may be considerably increased under load? We are asked to believe that the mechanical efficiency of the engines was greater than the efficiency of the generator, and are told that no reasonable person will doubt the engine efficiency to have been 96 per cent. This is followed by the still higher claim of 97 per cent. for the other engines.

Ever since the Glasgow station was set to work, American papers have had frequent references to the super-excellence of the American engines, and the absolutely contemptible meanness of the English engines. We have seen nothing to the contrary in any American paper, excepting only the *American Machinist* which admitted a letter from a Swiss steam engineer strongly animadverting on the gross unfairness of the American paper or papers, and expressing his opinion very much to the contrary in respect of the excellence of Messrs. Musgrave's engines. Seeing the latest phase of the question, and the manner in which Mr. Parshall's letter has been treated—a letter which says nothing of the Musgrave engines—we think it desirable to lay open the whole matter, so that corporation officials and others may at least have their eyes open before they consent to pay 20 per cent. extra for engines of poorer quality than can be had from home makers.

In conclusion, we may add that it is strange that, while the details of the tests will not be available to the public until they have been approved by the Corporation in September, they have in some way become known, wholly or partially, to our contemporary, and are being used in a sense hostile to British interests.

Batteries for Gun Sights.—The need of a small battery which would be capable of giving a steady current for two or three hours at a time and would not require much attention, is perhaps nowhere more felt than in the Navy where modifications of the Leclanché are in general use. This applies more especially to the gun sights used at night time when all lights are obscured—small pea lamps which shine on tiny reflectors so made as to show a little point of light on the foresight and a bar on the back sight. The present batteries consist of three large sized agglomerate cells placed in a convenient position near the gun, where a resistance switch can be adjusted to keep the sight at a fairly uniform degree of brilliancy. These batteries are well designed, and are kept in watertight boxes to protect them from rain and sea water, but there is naturally a good deal of room for improvement in the matter of giving current for long periods. In an attack by a flotilla of destroyers or torpedo boats, the guns have to be manned for the greater part of the night, and these little lamps are used for adjusting the distance on the sighting column; the guns must be ready at once on any suspicious shadow appearing, and a good deal of precious time may easily be wasted at the switch, fumbling about and trying to get the sights properly illuminated. The present batteries consist of an ebonite container of cylindrical form with a rod of carbon having six grooves in it for the reception of agglomerate rods which are held in place by rubber bands and wrapped round with coarse sacking. The zinc element encloses the whole, and the top is sealed with pitch composition.

SIGNALLING FOR RAILWAY TUNNEL WORKING.

Probably no class of railway accident is so terrifying to passengers, even when of a trivial character, as those which occur in tunnels. The liability to panic which is present at all railway accidents is greatly enhanced under such circumstances by the darkness, the difficulty of exercising control over the passengers, the uncertainty of location and direction, and the fear of further disaster from trains travelling in the opposite direction. Such accidents are, fortunately, very rare under the stringent arrangements for working traffic through tunnels, but the possibilities are undoubtedly present, and when such accidents occur the difficulties attendant upon accidents in the open are greatly accentuated. The necessity for some means of communication between the train staff and signalmen controlling the entrance of trains into the tunnels in such cases is evident, but there are not many cases in this country where such provision is made. Exception must be made for the arrangements in force in connection with the working of the Totley and Cowburn tunnels on the Dore and Chinley line of the Midland Railway, where a special wire is run on the up side of the line which, when broken, causes bells to ring in the cabins at each end of the tunnel, and warns the signalmen of occurrences necessitating the blocking of the lines. The company's servants accompanying trains which from any such cause come to a stand in one of the tunnels named, or the platelayers if they observe any defect rendering the tunnel unsafe for traffic, have instructions to break the wire, and put the signalling arrangements into operation.

Such an arrangement, however, can only be completely effective if the signalmen have control of all trains at the precise moment such a signal is received. If trains are passing through the tunnel in opposite directions at the same time, and a serious accident involving the fouling of both lines of rail occurs to one before the trains meet, the signalling arrangements are not likely to be effective since they are given to the signalmen only, and the conditions are such as require the notice to be given direct to the driver of the train which is approaching the obstruction.

The *Electrical Review*, of New York, of July 19th, contains an interesting description of special arrangements recently made in the Bergen Tunnel, Jersey City, of the Erie Railroad, to meet the conditions alluded to, and to provide direct intimation of danger to the drivers of trains in the tunnel, as well as to the signal operators at each end. Briefly stated, the arrangements comprise the provision of special signalling circuits on each side of the tunnel throughout its entire length, which control automatically the operation of a number of 8 C.P. ruby coloured incandescent lamps spaced at equal distances throughout the tunnel and on both sides. The lighting of these lamps is to be construed as a danger signal by drivers passing through the tunnel, and they are required to act accordingly.

The incandescent lamps, of which 92 are placed on each side of the tunnel, are fixed at distances of about 50 ft. apart, and are arranged in four separate circuits. Two of these circuits—one on each side of the tunnel and passing half way through it—are operated from the east end of the tunnel, and two similar circuits are operated from the west end. The lamps are operated by means of storage batteries placed at each end of the tunnel. Each battery consists of 100 Willard 100 ampere-hour cells, and the charging is done at the east end of the tunnel from a 1,500-volt, 9·6-ampere Brush arc lamp circuit lighting the yards at Jersey City, and at the west end from the city circuits at 500 volts, the current being reduced to 10 amperes to suit the cells. Full control of the circuits for charging, &c., is given at each end by means of a switchboard on which all necessary apparatus is mounted, and should a signal be received from the tunnel during charging, automatic apparatus provided cuts off the supply and puts the cells on the tunnel circuits, so that the high pressures used for charging are not applied to the lamp circuits. The switchboard apparatus also enables the signalmen to directly control the operation of the lamps after a signal has been received, and means for testing the circuits, &c., are also provided.

The signalling circuits, of which there are two, are

entirely separate from the lighting circuits, and are metallic throughout. Each circuit runs from cabin to cabin, and the return wire of each is on the opposite side of the tunnel to the outgoing wire. These circuits are always closed, and are each operated by 30 gravity cells placed in the signal cabins. On the switchboard at each cabin are fixed two electro-magnetic switches, which, when released, connect the cells to the tunnel circuits. The coils of the auto-switches form part of the respective signalling circuits, and the switches are maintained in the off position by the currents in the signalling circuits. Hence a disconnection of either of the signalling circuits releases the electro-magnetic switch at each end of the tunnel, and puts all the lamps into use. Such disconnection may be made by means of plug switches inserted in the signalling circuits for the purpose at about 200 feet apart, and on both sides of the tunnel, or it may result from the mechanical severance of the signalling wires by the wreck of a train in the tunnel. In the latter case damage would probably occur to the lighting circuits as well, but only one of the four circuits would be affected, leaving 138 lamps to give warning to approaching trains.

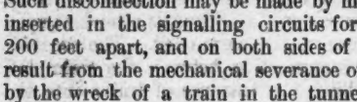


Fig. 3.

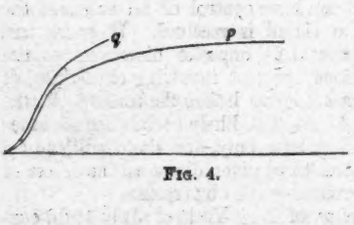


Fig. 4.

The whole of the arrangements seem to be very complete, and show the minuteness with which railway signalling is being studied in the States, and the lengths which some of the railways are prepared to go in order to ensure the safety of their traffic. It requires but a very cursory examination to ascertain that the installation, whilst favoured with facilities at hand for charging purposes, must have been somewhat costly, and it is to be hoped that "the satisfaction that the Erie Company can take in thus safeguarding its service, *will* compensate for the expenditure involved," and that the example thus set will be followed by other companies, not necessarily, however, on the same lines, but with a similar object.

VIBRATING CABLE RELAY.

By K. GULSTAD.

(*Concluded from page* 295.)

In order to be able to utilise the properties of the vibrating relay, something more, however, is required of the local current than to make the tongue vibrate at a certain rate. This would, namely, neither guarantee that dash-signals sent to the relay would properly control the vibrations, nor that the latter would, for instance, prevent the dashes sent through line L_1 from running together.

Accordingly, as hinted in connection with the ideal relay, not only must the rate of vibration be "O.K.," but, whenever the tongue is retained at one of the contact-stops by positive or negative cable dashes, the rate of increase of the local current with time must also be a proper one, and correspond to the increase of the cable current.

Figs. 3, 4, and 5 are intended to make this clear by illustrating the interference between the actions of the cable and local currents through the two sets of windings of the relay, it being here supposed—but certainly only for the sake of simplicity—that both windings are equal in all respects, whence the respective current strengths may be considered proportional to the magnetic actions and as representing the same.

Fig. 3 represents the curve of arrival for a current sent by station A through the cable and the line winding of the relay, corresponding to the thick line, fig. 5.

Fig. 4, P represents the curve of arrival for the local or auxiliary current sent by the relay through *p*, fig. 1, and the local winding, corresponding to the thin line, fig. 5.

In fig. 5 the straight lines, M and N, on both sides of the zero line, Z Z, indicate the current strength, *a*, just required to counterbalance the natural magnetic attraction between the armature and the poles of the electro-magnets.

The thick undulatory line shows current waves produced by currents when a series of dots succeeded by two dashes, or one dash and a dot, are sent through the cable. The thin undulatory line represents the corresponding curves for the vibrating local current, but here it must be understood

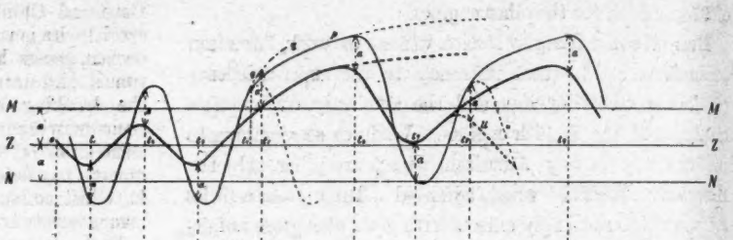


Fig. 5.

that the direction of the local current action on the same side of zero line, is always opposite to the action of the cable current, *i.e.*, if the magnetism due to the cable current is taken positive above zero line, the magnetism developed by the auxiliary current above the same line will be negative, and *vice versâ*.

The ordinates of the said curves give the respective and relative current strengths at the same time, the latter being reckoned as abscissæ along the zero line, say from *o*.

The left side of fig. 5 illustrates the interference between the two opposite currents, and the relative positions which the cable dots and the local current dots (vibrations) may be supposed to occupy. The armature of the relay would then be reversed at times t_1 t_2 t_3, *i.e.*, when the difference between ordinates equals *a*. This does not happen at the next equal time interval, t_4, because here the dash emitted from the sending station has caused the current to increase, thereby preventing the reversal. On the other hand, the tongue of the relay now resting for a longer period at the copper contact, will also allow the local current strength to increase in due manner as indicated by curve *p p*, viz., both currents increase simultaneously.

When the dash is completed at the sending station, the curve of arrival will decrease, while this does not affect the curve of the local current until time t_6, when the armature will be suddenly reversed, thereby also reversing the action of the local current, and so on, as shown in figure, the times of reversal being t_7, t_9. In case the first cable dash-signal was succeeded by a dot, the two curves would fall off as dotted lines U, *u*, time of reversal being t_8.

The result of this mutual action or interference between the two currents mentioned, appears from signals marked A, B, C (fig. 5), the time periods to be reckoned from *o*.

A shows transmitter signals sent from station A, fig. 1. These signals would, of course, be somewhat in advance of the corresponding current waves through the relay windings.

B shows the only possible distorted signal produced at the

relay station by these transmitter signals, the auxiliary current not being switched on.

C shows the signals transferred by the relay when the auxiliary current is switched on and currents interfere. When the first cable dash is followed by a dot, the third marking signal will cease at ↑.

Having now demonstrated how the said interference may change the distorted signals into correct ones, the question arises how to produce a proper curve of arrival, fig. 4. As already alluded to above, a curve that causes proper vibrations is not sufficient. For instance a curve of shape Q in fig. 4, which up to time t_4, corresponds very nearly to the local current wave in fig. 5, but which after that time rises quicker than the original curve $p\,p$, as shown by $q\,q$, would cause the armature to be reversed at t_5, *i.e.*, the dash signal as signified at C, would be far too short (up to ↓) or more likely be broken in two. In the same way curves similar to P, fig. 4, but less increasing for the latter part, would either produce dashes too long, or make them run into each other.

Generally speaking, to attain the rate of dots wanted, the essential thing required is that the current through the local circuit after a fixed short period should be of a certain strength, a condition which may be fulfilled by any number of curves by altering the relation between resistance and capacity in the local circuit, fig. 1. Omitting here for the sake of simplicity the condenser m, and the resistance n, the same number of vibrations per second may, for instance, be produced by increasing r and p, while at the same time diminishing capacity a, or *vice versâ*, but only one of the corresponding curves, fig. 4, will be best fitted for producing the proper dashes, because the current strengths, although equal after a certain period (defined by the rate of dots) will vary whenever this period is surpassed.

Considering, further, that the latter part of the arrival curve, fig. 4, is dependent more on the resistance in circuit than upon capacity, it will be easily understood that the required curve may be found simply by observing the signals produced by the relay. As a principal rule, I may mention that dashes appearing too short or too long would require respectively more or less resistance, for instance, in p, fig. 1, the capacity at the same time being reduced or increased. Instead of altering the capacity, the same object may be attained by changing the position of condenser a, fig. 1, in respect to resistances on both sides of it, &c.

Quite another but rather limited way in which to secure proper relay signals would be to vary curve fig. 3 instead of curve fig. 4, viz., to bring the cable current into conformity to the requirements by altering the condenser c and the shunt s, fig. 1. As to fig. 5, I may mention that no regard has been taken here to any condenser action upon the cable current.

Without going into details, the above may suffice to show that certain rules may be given as to the *modus operandi* for regulating the action of the relay, the rules being based upon the behaviour and qualities of circuits containing shunted condensers. Some few mathematical calculations regarding this subject are given in the Appendix.

On the other hand, the very operation of regulating is well adapted to demonstrate the influence of alterations in the circuit, sometimes in a most convincing manner, where ordinary cable signalling instruments would show no such effects.

Before turning from the above-mentioned more theoretical consideration to the use of the vibrating relay in practice, I will only remark that the former, though not touching several points of consequence, so far seems to be all right, as theory and practice apparently agree.

The vibrating relay, according to the principle described, is now used in connection with several of the Great Northern Telegraph Company's cables, with minor additions to, or simplifications in arrangement (fig. 1), dependent on the length of cables, requirements of speed, &c.

In other circuits the arrangement shown in fig. 18 in my former article has proved sufficient.

Wherever the vibrating relay has been applied, at once a very considerable increase in the maximum speed otherwise attainable has been the result, although this increase, as may be expected, does not appear to be in proportion to the K R of different cables, when the very same relay arrangement is used in all cases. Something similar applies to the rate at which duplex translation may be performed. The suitableness for this kind of work is another advantage attached to the double-wound vibrating relay, compared with the single-wound type.

As to the actual speed attainable, I may again refer to the relay performances at the station of the Great Northern Telegraph Company at Gothenburg, where signals from Newcastle through one of the North Sea cables are transferred to Nystad, in Finland.

For comparison it may be stated that in this case a delicate cable relay, well adjusted and worked in the old fashion, will translate up to 30 words a minute, while the maximum speed is now increased to 120 words per minute by applying the vibrating relay, the play of the tongue between the battery contacts at the same time being greater than in the former case. The ordinary daily working speed from month to month is 90 words per minute on this circuit.

As a specially interesting circumstance, it may lastly be mentioned that automatic switch translation can very well be used with the vibrating relay, although certain difficulties are met in connection herewith on long cables. The high speed at which the relay permits working through longer cables, of course renders, for instance, the ordinary P.O. switch-relay system useless in establishing this auto-translation.

To overcome this difficulty, Mr. Falck, the Great Northern Telegraph Company's superintendent at Gothenburg, a long time ago devised a special kind of switch-relay arrangement which has given much satisfaction, but whose closer description is outside the scope of the present article.

APPENDIX.

The figure below indicates a circuit where E is an electromotive force, r and r^1 resistances, F a condenser of capacity F.

FIG. 6.

The circuit may roughly be considered similar to the local circuit of the vibrating relay.

Let p be the potential of condenser F, and s_r, s_{r^1}, s_p, the strength of current passing through resistances r, r^1 and F, the latter to be looked upon as a secondary cell of no internal resistance and of varying potential p.

Then at any moment after circuit is closed—

$$s_r = s_p + s_{r^1}$$
$$s_{r^1} r^1 = p$$
$$s_r r = \mathrm{E} - p, \text{ E and } p \text{ being opposite in sign,}$$

whence $$s_p = \frac{\mathrm{E}}{r} - \frac{r + r^1}{r\,r^1} p.$$

When q = quantity of electricity in condenser F at any time t,

we have $$q = p\,\mathrm{F}, s_{r^1} = \frac{q}{\mathrm{F}\,r^1},$$

and further, $$s_p = \frac{dq}{dt} = \frac{dp}{dt}\,\mathrm{F} = \frac{\mathrm{E}}{r} - \frac{r + r^1}{r\,r^1} p,$$

or $$\int dt = \mathrm{T} + \mathrm{C} = \mathrm{F}\,r \int \frac{dp}{\mathrm{E} - \frac{r + r^1}{r^1} p}$$

$$= -\frac{\mathrm{F}\,r\,r^1}{r + r^1} \int \frac{d\left(\mathrm{E} - \frac{r + r^1}{r^1} p\right)}{\mathrm{E} - \frac{r + r^1}{r^1} p}$$

and $$\mathrm{T} + \mathrm{C} = -\frac{\mathrm{F}\,r\,r^1}{r + r^1} \log_e \left(\mathrm{E} - \frac{r + r^1}{r^1} p\right),$$

as $\mathrm{T} = 0$ gives $p = 0$. Constant $\mathrm{C} = -\frac{\mathrm{F}\,r\,r^1}{r + r^1} \log_e \mathrm{E}$, and finally

$$\mathrm{T} = -\frac{\mathrm{F}\,r\,r^1}{r + r^1} \log_e \frac{\mathrm{E} - \frac{r + r^1}{r^1} p}{\mathrm{E}},$$

or $$\frac{\mathrm{E} - \frac{r + r^1}{r^1} p}{\mathrm{E}} = e^{-\frac{r + r^1}{r\,r^1} \frac{\mathrm{T}}{\mathrm{F}}} \text{ where } e = 2{\cdot}71828,$$

and

$$p = \frac{\mathrm{E}\, r^1}{r + r^1}\left(1 - e^{-\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}}\right)$$

$$q = \frac{\mathrm{E}\, \mathrm{F}\, r^1}{r + r^1}\left(1 - e^{-\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}}\right),$$

inserting value of p and q in equations above

$$s_p = \frac{\mathrm{E}}{r} e^{-\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}},$$

and

$$s_{r^1} = \frac{\mathrm{E}}{r + r^1}\left(1 - e^{-\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}}\right) = \frac{\mathrm{E}}{r + r^1}\left(1 - \frac{1}{e^{\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}}}\right).$$

From the latter equations it appears that current through r^1 will develop in the same way if values of r and r^1 are interchanged.

If $r + r^1$ is constant a, the increase of s_{r^1} with time will be minimum or the condenser action will be maximum when $r\, r^1 = y$ is maximum.

Now

$$y = a\, r - r^2,$$

and

$$\frac{dy}{dr} = a - 2\, r = 0,$$

or

$$r = \frac{a}{2},$$

that is, $r = r^1$ will give maximum for condenser action.

As to current strength s_{r^1} after a certain time, it is, of course, not generally proportional to the product of capacity and resistance.

When, for instance, $r = r^1$,

$$s_{r^1} = \frac{\mathrm{E}}{2\, r}\left(1 - e^{-\frac{2\,\tau}{r\,\mathrm{F}}}\right),$$

but doubling the resistances and reducing the capacity to the half will give

$$s_{r^1} = \frac{\mathrm{E}}{4\, r}\left(1 - e^{-\frac{2\,\tau}{r\,\mathrm{F}}}\right),$$

which shows that the current strength in the latter case is only half the strength in first case, although the named product is equal in both cases, the capacity being of less importance.

From the general equation,

$$s_{r^1} = \frac{\mathrm{E}}{r + r^1}\left(1 - \frac{1}{e^{\frac{r + r^1}{r r^1}\frac{\tau}{\mathrm{F}}}}\right),$$

it will be seen that any number of current curves, for same current strength after a fixed period, may be had by properly varying F, r and r^1, s_{r^1} will increase when F, r and r^1 are diminished and *vice versâ* (product $r\, r^1$ being of more importance than $r + r^1$).

When r^1 is small in comparison with r,

$$s_{r^1} \text{ is approx.} = \frac{\mathrm{E}}{r}\left(1 - \frac{1}{e^{\frac{1}{r^1}\frac{\tau}{\mathrm{F}}}}\right).$$

From this it appears that the same variations in resistance here are of greater effect when made in r^1 than in r. In the local circuit of the vibrating relay, fig. 1, this will generally be the case for r in comparison with the greater resistances p and n.

REFUSE DESTRUCTION: ITS SANITARY AND STEAM-RAISING ASPECTS.

By FRANK BROADBENT, M.I.E.E.

(*Continued from page* 294.)

V.

There is, in the lay mind, the idea that water-power, being "a free gift of nature," costs nothing. It is, however, generally found that this free gift involves, what has been termed, a considerable "legacy duty." This duty takes the form of interest and depreciation on waterways, buildings and masonry, labour, &c.; a duty which may, quite possibly, amount to as much as, or more than, the cost of the coal or other fuel saved. The fact is, that water, not water-power, is the free gift. It is possible that, to some extent, this same idea is held in relation to the raising of steam from refuse. The same argument should certainly hold good, for if water-power be free, because water costs nothing, then, on the same basis, refuse power should be free also.

It is, however, easily shown that it is not so. By the time the refuse is delivered on the site of the destructor, it has cost in handling and cartage from one to two shillings, or more per ton, depending upon the distance it has been carted, the nature of the district, and the supply of horses and other labour. (This cost will be approximately the same with or without a destructor, and it will not be treated, therefore, as a charge against the latter.)

Then, before it is finally disposed of, the refuse has cost, in firemen's and trimmers' wages, about another shilling per ton. This is the average cost of destruction per ton in this country. In some cases the cost works out below this, and in others it is exceeded; but under working conditions it is not hard firing for two stokers, with the help of a trimmer, to deal with 1½ tons an hour. At a push, say, when the peak of the load comes on, this rate can be considerably increased, in fact, doubled.

Assuming 1s. 6d. an hour for the three men, the cost works out to 1s. per ton, taking the easy rate of 15 cwt. per hour per stoker.

At Hereford, Grays, Torquay, Warrington, Oldham, &c., the costs of destruction are from 9d. to 9¾d. per ton, whilst at Rochdale, Chesterfield and Liverpool they are 7½d. and 8¼d. respectively.

In addition to the cost of destruction there are the standing charges to be added, made up of interest, depreciation and sinking fund. Management expenses need not be considered, as these would consist in nominal supervision by the district surveyor. As the annual amount of refuse to be destroyed is known, the standing charges per ton can be approximately predetermined.

Take a case in which 20 tons a day are to be destroyed, and, in order to meet the conditions of a small electricity works, assume a working day to be eight hours. This gives us a rate of 2½ tons an hour.

The approximate cost of a destructor to deal with this quantity, complete with boiler for forced draught, flues, chimney and buildings would be £4,000. Taking 10 per cent. for interest, depreciation and sinking fund, the annual amount to be set aside to cover these charges is £400, or approximately 1s. 1d. per ton, which, added to the cost of stoking, &c., makes a total cost of 2s. 1d. per ton. Instead, therefore, of considering it as a free source of power, refuse must be considered as equivalent to coal, costing, including firemen's wages, about 12s. 6d. a ton; that is, assuming its steam raising power to be about one-fifth that of coal, and deducting 15 per cent. to 20 per cent. of the steam for forced draught purposes. This makes six tons of refuse, the equivalent of one ton of coal.

In a combined station certain economies can be effected in buildings, and the cost of the chimney would not be entirely debited to the destructor, as this is an essential in any case. Neglecting for the moment the possibility of making a profit on the clinker, the point is, Can a refuse destructor and an electricity works be combined with mutual advantage? The electrical department's attitude is, "We don't want to be bothered with your refuse, but if you have any steam to spare, you can send it along."

When a refuse destructor has been decided upon, and this is the ultimate sanitary solution of the refuse disposal problem—the whole of the costs referred to above will be entailed, whether the destructor heat be utilised for steam raising, or merely passed direct into the chimney.

Why, then, should the electricity department be asked to subscribe to costs which are not necessarily incurred on its behalf. It might argue that if it provided the necessary extra boilers and accessories, the Sanitary Committee should be satisfied that its waste heat was turned to a useful purpose. On the other hand, the sanitary department may consider that having delivered the refuse on site, the electricity department should be only too pleased to do the rest in return for free fuel. It is clearly a case for compromise, and is decided in different ways by different bodies. Take Mexborough as an example. There the Sanitary Committee runs the destructors and boilers; the Electricity Committee the generating plant; and the Highways Committee buys the electricity in bulk and retails it; a most unusual arrangement! At the opening of the combined works at Mexborough, in May last, the vice-chairman of the Council put the case in this way:—"In the year 1901 the disposal of night soil and bell cart rubbish, amounting to some 86 tons per week, cost the town £456 a year, and it had to be carted to Harlington Lane and elsewhere, to pollute the atmosphere and the soil. Under the present scheme the refuse is destroyed, and with its destruction steam is generated for

the production of electricity. If the Council had to purchase coal, about 300 tons a year would be required, and this at 10s. 5d. per ton delivered would cost about £150. To this must be added stokers' wages, £102 16s., giving a total of £252 16s. It was found that 6½ tons of night soil and refuse equalled 1 ton of coal, and for the destruction of the night soil and refuse it would take £280 16s. in wages of stokers, and other charges. As against that, there was a saving of £111 4s. in shorter cartage of night carts at 6d. a ton, and an income of £200 or more for steam supplied to the electric station."

This puts the position clearly, although some of the figures require a little explanation. Thus, if 6½ tons of refuse equal 1 ton of coal, and the estimated amount of coal required annually is 300 tons, the amount of refuse burnt for steam-raising purposes for the electricity works will be 6½ × 300 = 1,950 tons. But as 86 tons per week equal 4,472 tons per annum, obviously more than half the refuse is unproductive. This is due, no doubt, to the present small electrical output; and the time may arrive when the whole of the refuse will be used for steam raising. This practical case affords an argument against the idea that an electricity works should pay all the costs of stoking, as in the early stages of an undertaking only a portion of the refuse is productive. Another point to be noted is, that by the proposed arrangement the electricity works saves £52 16s. per annum as against using coal. The saving is really more than this, as there are no standing charges on boilers, pumps, economiser, chimney, &c., to provide for in this case in the electricity works accounts. The sanitary authority also is about £30 to the good, taking into account the saving in carting expenses. This £30, plus any income derived from the disposal of clinker, helps to pay the standing charges of interest and depreciation, &c., on the destructor works.

When the time comes that the whole of the refuse is profitably employed in raising steam, the income from that source, on the same basis, will be about £450, producing a balance in favour of the sanitary department of about £280 to set against standing charges. As these, at 10 per cent., will be about £450, it looks as though the electricity works would benefit at the expense of the destructor works.

From the figures given for refuse firing, it would appear that 1s. 3d. per ton is the estimated cost of wages for stokers, &c., whereas coal firing is rated at 6s. 10d. a ton. This at first sight seems very disproportionate, but the amount of coal used would be less than 1 ton per day, and a stoker must be in attendance the whole time, whereas, in the case of refuse, about 12 to 15 tons per day are dealt with by two stokers and a trimmer; hence, the figures are not very wide of the mark. Looked at from an electricity works point of view, it would appear, under similar conditions to the above, to be considerably cheaper to put down a destructor than to burn coal, charging the sanitary department with the cost price per ton for destroying any refuse not used for steam raising; the sanitary department, of course, delivering the refuse free to the destructor.

Thus, on the same basis as the foregoing, the destructor portion of the plant, excluding boilers, pumps, chimney, and any other item necessary in any case to the electricity works, would cost approximately £1,400; add for land and buildings £1,100, making a total of £2,500. The loan raised is to be paid off in 23 years; in the meantime, interest on the balance is to be paid at the rate of 3¾ per cent. per annum, or an average on the original amount of slightly under 2 per cent. per annum. A total of 10 per cent. per annum therefore covers interest, repayment of capital, depreciation and management, which works out to 1s. 1½d. per ton on the total amount of 4,472 tons per annum. Add to this the cost of stoking—1s. 3d. per ton—and we get as the total cost of destruction 2s. 4½d. per ton.

To compare the cost of refuse with the cost of coal, the above figure must be multiplied by 6½, on the assumption that 6½ tons are equal in steam-raising value to 1 ton of coal. This amounts to approximately 15s. 6d., whereas it has already been shown that the cost of coal, including firing, is 16s. 10d. On this basis, therefore, there is a saving by refuse firing equivalent to 1s. 4d. per ton of coal otherwise required.

The saving would possibly exceed this, as 1s. 3d. per ton for refuse firing is a high figure to assume; and it might also be found, as is usual in colliery districts (see Table IV. in the last article), that 6½ tons of refuse are worth more than 1 ton of coal.

TABLE V.—Data in Connection with Refuse Destructors at Electricity Works.

Locality and nature of refuse.	Population.	Tons per day per 1,000 of population.	Weight of refuse burnt per day.	Useful B. of T. units per ton of refuse.	Remarks.
Accrington (unscreened refuse).	38,000	0·8 ton.	30 tons.	20 units (maximum load 111 KW.)	Average over a month.
Grays Thurrock (unscreened refuse).	13,500	0·89 ton.	12 tons.	35·5 units (1)	(1) Test run; average for last 4½ hours.
	"	"	"	42·4 " (2) (maximum load 80 KW.)	(2) Test run; average for last 3 hours.
St. Helens (unscreened ashpit refuse).	90,000	—	26 tons (coal also used).	38 units.	Average result, and is additional to supplying steam continuously to two mortar mills.
Shipley (ashpit, privy, market and slaughter house refuse).	24,000	0·88 ton.	21 tons.	38 units (maximum load 110 KW.)	Average over a month. Results will improve as load on station increases.
Shoreditch (ashbin refuse).	124,000	0·56 ton.	70 tons (coal also used).	26 units.	Average over a year.
Wrexham (unscreened refuse).	14,500	1·1	12 tons.	37·8 units (maximum load 150 KW.)	Average over a month.

From inquiries the writer made on the spot, Mexborough refuse forms no exception to the rule, and it may be found in practice that the results exceed the estimate.

There is nothing in the Mexborough speech quoted, to indicate on what basis the electricity works is to be charged for steam. It is simply stated that the income will be £200 or more; and, if the figure 1,950 tons a year be correct, this figures out to just over 2s. per ton of refuse used, or practically the same figure as we arrived at in our hypothetical case.

Reliable data are now available from other combined stations showing the average number of electrical units (*i.e.*, Board of Trade units) per ton of refuse destroyed.

This information is given in Table V., from which it is clear that, in a well-designed system, an output of 35 units per ton should not be difficult to maintain.

The average cost of coal per unit in 20 small electricity works in England and Wales, that is, in works having a maximum load of under 200 KW. (say 300 H.P.) is just over 1¼d. (to be accurate, 1·3d.); so, if the Sanitary Department were credited with 1¼d. per unit generated, it would receive, on the basis of 35 units per ton, 3s. 7¾d. per useful ton of refuse consumed.

But the Electricity Department would want to share in any advantage gained, and would therefore, naturally expect to pay something considerably under the average cost of coal.

The engineers would doubtless assume that they could produce electricity at the lowest, not the average cost. The lowest cost in any of the 20 stations referred to is that of

Leigh, viz., ·34d. On this basis the sanitary department would receive only about 1s. a ton, which would barely cover stoking costs. It is clear that in order to cover the costs of destruction and standing charges, say 2s. a ton in all, the sanitary department must be debited with about ¾d. per unit generated. From the above argument it follows that when from 10 to 30 tons of refuse per day are to be destroyed, if the plant be so designed that the total costs of destruction, including standing charges, approximate 2s. per ton, an electricity works might with advantage be run in combination with the destructor, if the demand for electricity be such as to permit of the whole of the refuse being usefully employed in raising steam.

The advantage would be mutual, as the destructor costs would be covered, and the fuel cost to the electricity works would be below the average.

The general arrangement of the destructor at Grays was shown on p. 292. This is a 2-grate "Simplex" destructor by Meldrum Bros., of Manchester, a firm who, by the good work they have accomplished, and their willingness to publish results of tests, have done a great deal to popularise the idea of refuse cremation. It will be seen from the illustrations that the refuse bunker is in the open air outside the building, immediately opposite the firing doors. The refuse is raked forward by the trimmer on to a sill, from which it is handled in the same way as coal.

(To be concluded.)

Re EARTHING THE MIDDLE WIRE IN THREE-WIRE DISTRIBUTING SYSTEMS.

By G. HOOGHWINKEL, A.M.I.E.E.

It seems as if Mr. Faraday Proctor's paper on "Earthing" has at last succeeded in exciting some discussion upon the above problem, so important both to consumers and to distributing companies. Another article entitled "The Question of the Earthed Return" in the ELECTRICAL REVIEW, of August 8th, further calls for discussion upon this subject.

Some time ago the writer approached the Board of Trade on behalf of the company he is connected with, for permission to put down a three-wire distributing system with an uninsulated middle wire. Together with some technical notes on the subject, he took the trouble to compile a list of some large systems in Germany where this system was successfully worked for many years. This was the "surprising list" Mr. Trotter referred to in his discussion on Mr. Proctor's paper.

The opinion of six engineers, of whom one hesitated to give an opinion, a second thought it would do in small jobs (the contrary is more evident), and the others would not consider it at all, scarcely throws any light on the subject, and if a more scientific and practical discussion can be induced by these notes, the writer will be amply repaid.

Mr. Kapp's remark, that the list did not represent the whole of the load in the different towns, is rather a recommendation of the system, the output having been taken from the writer's own pocket-book kept at the time when he was putting down some of these stations, and from the German *Electrical Review* of some years ago, thus showing that the output has considerably increased.

The system in discussion is almost universally used on the Continent. In fact, most of the modern lighting schemes are laid with this arrangement of the neutral. It is, moreover, often specified by local authorities in German towns, when putting down their own plant, and is adopted whether traction schemes already exist or not. It may be mentioned that on no occasion, to the writer's knowledge, has the uninsulated middle wire been opposed by the postal or telephone authorities, which bodies in Germany are even more exacting than in this country.

It is the practice in England to lay the neutral conductor in three-wire continuous-current systems of a section equal to about 50 per cent. of the outers, and this size has been more or less standardised by the cable makers.

On the Continent a proportion of about 25 per cent. for the neutral conductor is the rule, and it can easily be proved that this is quite sufficient in a well-designed network. Therefore considerable reduction of capital cost could be effected by adopting a system with the bare neutral wire, laid in the ground without any protection whatsoever, and linked up at the different connecting points, the section being about 25 per cent. of that of one of the outers.

The advantages of using a bare neutral wire are (1) greater reliability in working; (2) cheapness of distributing mains; (3) cheaper and easier house-service connections; (4) and facility in laying distributing cables on both sides of a street without greatly increased capital expenditure, as the middle wire can be readily divided and taken down each side of the street together with one of the outers.

As the advantages 2, 3 and 4 are evident, there only remains the first to be investigated.

The allowable loss of volts in the middle wire over its entire length may be taken as 3 volts, if no great number of arc lamps are in circuit. In the latter case it is usual to allow a loss of volts on the middle wire equal to only 1 volt. With a difference of pressure of 3 volts, no danger to gas or water pipes, or of telephone disturbances is possible; of course practically no current passes through the earth.

If the middle wire is too small, a portion of the neutral current will find its way through the earth, in which case the bare wire will begin to get oxidised. Other things being equal, the earth currents or leakage currents will become smaller the less the potential differences between various points in the middle wire, and also the smaller the surface of the middle wire in contact with the earth, and the larger the extent of the network in one direction, that is to say, for elongated networks a greater loss of voltage can be allowed in the middle wire than in the shorter networks. However, it is necessary to calculate a bare middle wire with some margin, not only to reduce the drop of voltage, but also to compensate for the loss of section, due to oxidation, which, however, largely depends upon the surrounding soil.

It is a well-known fact that, given two equally well insulated leads, the negative one shows after the same time much lower insulation (caused by osmosis), which can at times reach such limits that the negative finally goes to earth.

These insulation faults mostly arise in houses, but if a bare middle wire is used in the distributing system, these faults become less troublesome, because owing to the earth on the middle wire, the house fuse in the respective outer goes. Before the light can again be set right, the faults have to be repaired. Thus, an uninsulated middle wire is more reliable, as faults in the outers will not remain unlocated or unrepaired.

In an installation of several thousand lamps, it is impossible, practically, to carry out a systematic control of the insulation. In cases where an insulated middle wire is used, the negative lead will in time have a more or less complete earth at certain points, as experience has taught in many towns.

As long as the insulation of the two other leads remains good, this circumstance can only cause disturbances in telephones in the form of leakages of current from one faulty spot to another on the negative lead, in proportion to the differences of potentials. These potential differences, as a general rule, do not exceed 2 volts, so that these disturbances cannot be very considerable. These earth currents, however, will always be more important than the earth currents arising from an uninsulated middle wire, as in the latter the differences of potentials are not 2 volts, but only a fraction of a volt.

Circumstances, however, alter to the disadvantage of the insulated middle wire if through any cause an insulation fault arises in it or in the positive outer lead. These faults, or earths, might be removed from each other by the whole stretch of the distribution network, and if in the neighbourhood of these different points telephone connections with earth plates are to be found, the leakage currents will partly find their way into the respective telephone leads and apparatus.

It is also to be remarked that if the places at which there are faults do not develop a complete earth, the leakages of current might very easily become serious enough to disturb the telephone working but not serious enough to melt the

fuses. The disturbance, therefore, does not indicate itself, but remains on until by means of a systematic and lengthy test the faulty places are located and separated from the cable network.

On the other hand, if the middle wire is put to earth, the likely area within which earth currents can arise with insulation faults in the outers, and the length of time during which the disturbances can last, are considerably limited, and this limitation is the greater the larger the number of points on the middle wire which have complete earth connection.

If the middle wire is connected for its entire length direct to earth, the currents arising from insulation faults will pass from the faulty places to the nearest point of the middle wire, and will only utilise the earth in the second place. That is to say, in so far as the middle wire does not suffice to conduct the short-circuit current in its full strength. As the house fuses immediately go in this case, it results that this rush of current is limited to a few seconds only, and can produce no lasting disturbance, as it does in the case of an insulated middle wire.

In order to attain as nearly as possible the above described ideal conditions, the writer recommends the connection of the middle wire and the armour of the outer cable at intervals of about 50 yds. by means of copper section wires.

In adopting an uninsulated neutral wire, which has been successfully worked for many years in almost all of the larger towns on the Continent which have a three-wire continuous-current system, not only will economy be obtained, but also many of the difficulties which many engineers have encountered will be overcome.

There should be no fuses on the middle wire, neither at the station nor in houses, and the uninsulated middle wire must not enter the network boxes, but should be simply connected up by copper links.

THE INTERNAL COMBUSTION ENGINE.

By ED. C. DE SEGUNDO.

Prof. T. Hudson Beare read a most interesting paper in February of this year at a meeting of the graduates of the Institution of Mechanical Engineers, in which the history of the development of the gas engine, from the date of the trials carried out by the Society of Arts in 1888 to the present day, is admirably summarised.

There can be no doubt as to the great future which is opening out for the internal combustion engine as a rival to the steam engine, especially owing to the many successful systems of production of gas of low calorific value.

The utilisation of blast-furnace gas for power purposes has naturally reached a remarkable stage of development. The results obtained from the 600-H.P. Simplex gas engine at the works of the Société Cockerill at Seraing are still fresh in the minds of all interested in the internal combustion engine, but, with characteristic conservatism, British manufacturers have been slow to recognise the immense opportunities afforded by the utilisation of blast-furnace gas. Prof. Beare certainly does not overstep the bounds of prudence in forecasting for the utilisation of blast-furnace gas "a very remarkable future in this country."

In America the Westinghouse Company have for some time past been devoting their energies to perfecting a design of gas engine for large power, and are manufacturing a three-cylinder gas engine which will yield up to 1,500 B.H.P. This subject is also receiving great attention at the hands of German engineers, some 50,000 H.P. being at present at work in Germany.

Prof. Beare draws attention to Mr. Lürmann's statistics respecting the available power from the waste gases of blast furnaces. At Seraing waste gases from the production of about 600 tons of iron per day are sufficient to develop about 17,000 H.P., from which Mr. Lürmann calculates that in the whole of Germany, where some 8 million tons of pig iron are made per year, about 600,000 H.P. should be available.

A letter which has just reached me from Messrs. Mather and Platt, of Manchester, points to the fact that manufacturers in England are now beginning to recognise the important commercial features attaching to the utilisation of the internal combustion engine as a means of producing power. The above-mentioned firm have now decided to manufacture gas engines of 400 B.H.P. and upwards, and have selected the "Körting" type of engine as the one which, in their opinion, is the most reliable and advanced in design. Prof. Beare refers to this engine in his paper, and describes the working cycle in detail. It is sufficient to say that although it is a double-acting engine, that is to say, although the piston receives an impulse both on the out and return stroke, the cycle has been ingeniously arranged to allow of the scavenging action which has been shown to play so important a part in the economy of the internal combustion engine. Messrs. Mather & Platt state that they are prepared to offer engines developing up to 800 B.H.P. in one cylinder, and further state that they are prepared to construct such engines to work with blast-furnace gas, Mond or other producer gas, or town's gas and to guarantee their satisfactory working. This is significant, and it is also interesting to note that the well-known firm of Tangye's, of Birmingham, are laying themselves out to manufacture gas engines on a larger scale. During a recent visit to their works, Mr. Henry Tangye pointed out to me several gas engines in course of testing, and in course of construction, varying from 150 to 350 H.P.; amongst these may be mentioned a very neat type of three-cylinder vertical engine specially designed for direct coupling to dynamos. The comparatively new shops of the "Tangye Tool and Electric Company" are driven entirely by electromotors, the power being supplied by continuous-current dynamos in the basement, driven by a 75-B.H.P. single-cylinder gas engine. So far Messrs. Tangye have adhered to the Otto cycle, but Prof. Beare is undoubtedly right when he says that the Otto cycle "is by no means an ideal one for many of the purposes to which it is proposed to apply the large engine now being built." This is borne out by Messrs. Mather & Platt's decision to manufacture the Körting engine.

To those interested in heat engine economy, the fascinating feature in the internal combustion engine lies in the wide range of temperature within which it is possible to work, and in the greater possibilities of improvement in thermal efficiency as compared with the steam engine.

The recent successful application of highly superheated steam has somewhat modified this advantage, but still, within the limits of what appears to be practical working in the future, it would seem that whereas the steam engine, even when working with superheated steam, has reached a state of development which approaches the limit of possible heat efficiency, the present state of the internal combustion engine is well within that limit.

Many years ago Dr. Kennedy drew attention to the fact that the ratio of the heat turned into work in a gas engine to that which it was possible to turn into work was very much higher than in the case of a steam engine.

It is interesting that in the same volume of the *Proceedings* of the Institution of Mechanical Engineers in which Prof. Beare's paper is published there is also an account of a trial of a triple-expansion steam engine for hydraulic pumping, the steam in this trial being highly superheated. In the tests quoted by Prof. Beare of a 400-H.P. Crossley engine, using Mond gas, and a 500-H.P. Premier engine, also using Mond gas, the heat efficiency, or the ratio of the heat equivalent of 1 H.P.-hour to the heat passing through the engine cylinder per B.H.P.-hour, was 23·73 per cent. in the first case and 25·6 per cent. in the second. The ratio between the heat utilised on the piston compared with the total heat supplied to the engine in the case of the triple-expansion engine using slightly superheated steam, the indicated heat-efficiency was between 17 and 18 per cent. The mechanical efficiency of the engine may be taken at about 85 per cent., and therefore the brake heat-efficiency may be taken to be 15·5 per cent.

Mr. Charles J. Hobbs, who carried out the trials on the triple-expansion steam engine, gives a calculation of the

thermal efficiency of the ideal engine working under the temperature conditions which obtained in these steam trials, and taking the recognised formula for the thermal efficiency for the Rankine cycle of superheated steam, this ideal efficiency works out to 24·2 per cent.; thus this triple-expansion steam engine has an efficiency ratio of 75·77 per cent., or, in other words, it is about three-quarters as good as it could be if it were working under ideal conditions. This would appear to leave a considerable margin for improvement in the steam engine, but the results in the particular trial, although an excellent result for the working of an engine in every day practice, are not by any means the best results that have been attained in a steam engine using superheated steam. Clearly with highly-superheated steam much better results would be expected, and have, in fact, been realised; a consumption of steam per I.H.P.-hour in well-authenticated trials of something over 8 lbs. has been attained. The ever-increasing activity displayed by Continental manufacturers in the development of the commercial use of the internal combustion engine is very significant, and it is encouraging to see that our manufacturers do not propose to be as slow in following up this line of thought as they have been in the past in other directions.

DISTRIBUTION WITH UNINSULATED NEUTRAL.

By E. MORGAN, A.I.E.E., Assistant Engineer, Newcastle Electric Supply Company, Limited.

In your issue of August 8th you invite discussion on the above question, which is, in the writer's opinion, undoubtedly one of the developments in electricity supply to be looked for in the near future.

In considering the question it may be best to discuss the probable lines of successful design of a new station laid out to meet the conditions of working with an uninsulated neutral.

The first point which appears quite clear is, that there will be no fuses *anywhere on the neutral* conductor either in the generating station, or in the streets, or in consumers' premises. As a necessary result of the assumed conditions, there can be no faults on any part of the neutral conductor, which at once clears away quite half the troubles the mains engineer has learned to expect. Answering the question, "What would happen if a dead earth occurred on one of the outers?" we at once see that fuses in the outers of the three-wire system will be a necessity. The question of employing fuses in the network, in the ordinary mode of supply with insulated neutral, is a debateable point, but the author thinks that these will be found to be a necessary evil.

Under the conditions we have assumed, however, properly-placed and properly-designed fuses would appear to be of great advantage, and should relieve the mains engineer of considerable anxiety. The author would place fuses between each feeder and the distributors connected to it, but not on the feeder itself. A switch on each outer on the station board will in practice be found sufficient protection for large feeders, as the current is always under observation. If it is decided to fuse the feeders, the fuses should be designed to melt at not less than 2,000 amperes per square inch. Wherever the section of distributor undergoes alteration a fuse should be inserted, and it would be quite possible to standardise a network with three sizes of distributors, involving, therefore, only three sizes of fuses. The author would fuse distributors for about 1,500 amperes per square inch, arranging the fuses in accordance with the section of main and not according to the connected load on the section.

With a network laid out as above described, it seems fairly certain that a dead earth or short circuit would be immediately located by the blowing of the distributor fuses, and only a small portion of the network would be rendered dead.

It has been said that with an earthed neutral it would be extremely difficult to locate faults, but it is not immediately apparent why there should be any great difficulty. As shown above, a bad fault would be to a large extent self-locating, and a small leak, not sufficient to blow the distributor fuse, would not entail stoppage of supply. There would therefore be plenty of time to locate it. Further, the method of breaking down and burning out the fault could be resorted to with impunity in this case.

To ensure safety it is obvious that the capacity of the balancers must be such that they can supply current sufficient to blow the largest fuse on any section of distributor.

The question of electrolysis and leakage resulting therefrom has been thought serious. But would there be any serious trouble with a concentric cable system, the negative pole being the inner and the lead the uninsulated neutral?—all disconnecting boxes and fuse boxes being partly filled with oil and the lead wiped on to the outside of each box, the cable being laid in troughing filled with bitumen in the usual way. This would be necessary for the protection of the lead from the chemical action of soils and the effects of leakage currents. In such a system suitably designed fuses form very handy means of disconnecting and splitting-up the system.

With regard to house wiring, there is clearly no difficulty with this, and the system offers many advantages, both as regards reduced cost and as likely to increase the standard of wiring work, and to make things more difficult for the jerry wirers; for with one pole permanently earthed these gentlemen would have to work carefully. It must be more satisfactory to the consumer to have faulty workmanship detected automatically than to experience trouble when the mains engineer endeavours to locate the fault on his wiring. For similar reasons the safety of house wiring with earthed neutral appears to be greater, for under present-day conditions it is possible to have a dead earth on the neutral of a consumer's installation (which possibly is switched off when the mains engineer tests his cables) for days together, with the ever present possibility of a fire resulting from a serious leakage on one of the outers of either the supply company's mains or those of another consumer. This possibility is increased in cases where it is the practice to make the neutral fuse on three-wire installations twice the capacity of either outer, with the object of preserving consumers' lamps from possible excess pressure.

The author's view is that if there is an earth on a consumer's installation, the sooner some of his lamps break, the sooner the fault will be rectified.

A further great advantage lies in the fact that it is impossible for anybody to get a shock to earth at the full voltage of the system. The possibility of this can never vanish so long as the existing system of removing the earth at will from the neutral conductor prevails.

Finally, the author commends the following system of distribution to the notice of engineers:—Three-phase current distributed by three-core cables, lead covered, the lead being used as earthed neutral, the lead being wiped on to all boxes, and services taken off by lead-wiped joints.

One might further consider the possibility of dispensing with the neutral conductor, and connecting one wire to the existing water or gas pipes in the consumer's house, but as this raises the rather involved legal query as to whether the consumer may thus utilise a portion of his own property while connected to the water or gas company's main, the writer will not pursue the subject further.

A EUROPEAN ELECTRICAL COMBINE.

An esteemed financial contemporary published about a week ago a short article from its Berlin correspondent entitled the "German Electrical Industry," but really referring to the annual report of the Bank for Electrical Enterprises, of Zürich, which is, of course, situated in Switzerland. It is not intended on the present occasion to deal with the points raised in the article, but in view of certain statements contained in it we have considered it desirable to turn to the actual report issued by the company. The Zürich bank now has a share capital of £1,320,000,

which is almost entirely held by the Allgemeine Elektricitäts Gesellschaft, of Berlin, for which it acts as a trust in Switzerland and other countries. Thus the A.E.G. virtually dominates the Swiss company, but we prefer to think that if the former has anything to make public it will do so on its own account rather than through a subsidiary company domiciled in a neighbouring country. The object of the Zürich bank is to assist in the promotion of electrical enterprises by subscribing for a number of shares, or investing money in another form of partnership, by advancing loans on current account, and by payments made in conjunction with other financial institutions on a common or syndicate basis. Taking the bank's report into consideration, we find it is interested in 11 companies operating in Italy, Spain, Germany and Switzerland, and of these six have yielded improved dividends during the past financial year, whilst the distribution has been less in the case of three of the remainder. Among the concerns may be mentioned the Italian Union Electric Tramway Company, of Geneva, the Genoa Electrical Works, the Seville Tramways Co., of London, the Seville Electricity Co., the Barcelona Electricity Co., the Viscaya Electricity Co., of Bilbao, the Strassburg Electricity Works, the Berlin Electricity Works, the Bitterfeld Electro-chemical Works Co. and the Electro-chemical Co., of Rheinfelden. The net income received by the Bank for Electrical Enterprises from these investments, after paying interest on its bonds, amounts to £89,400 for the past financial year as compared with £82,380 in the preceding twelve months, and the dividend proposed to be paid is at the rate of 6 per cent. as in the previous year, although on the present occasion, additional share capital to the extent of £120,000 participates in the distribution. This is a fairly satisfactory result obtained, as it apparently has been, from a prudent selection of investments in undertakings which have now mostly been in operation for several years, and which have seemingly outgrown their earlier struggles.

The position of an investment company, such as the Bank for Electrical Enterprises, with a sphere of activity extending over several countries, cannot endow any of its statements regarding the industrial situation with as much importance as those emanating from a leading manufacturing company, in touch with the details of the electrical trade from day to day, as, for instance, its parent concern, the A.E.G., of Berlin. Nevertheless, some of the bank's observations are of interest at the present moment. The report states that the enterprise business, that is, new undertakings, in which the bank is primarily concerned, has still further diminished in extent during the past year. This is mainly atttributed to the general economic depression prevailing in Europe, which has become accentuated in consequence of the uncertainty surrounding the result of the negotiations for the conclusion of new commercial treaties between different countries. It is also stated that the existing manufacturing establishments are more than sufficient to meet the present condition of affairs, and that the result is an uncommonly intense competition, and a price level which can scarcely yield a proper industrial profit. These remarks are not very original in their character, but the bank makes the somewhat novel suggestion that it will perhaps become a necessity for the European electricity companies—obviously the manufacturing concerns—to enter into closer relations on the lines of American combinations, whereby the less favourable-producing works could be temporarily brought to a standstill until the industrial circumstances have again improved.

We do not know, and it would doubtless be impossible to ascertain, who is really responsible for the inclusion of this suggestion in the report of the Bank for Electrical Enterprises. It is common knowledge that there is little difference between the financial position of most of the German and Swiss electrical manufacturing companies at the present moment, but hitherto it has been proposed that only the Teutonic firms should form a community of interests, and the names of the Allgemeine Elektricitäts Gesellschaft and the Schuckert Company have been associated together by way of a beginning, as has been previously mentioned in this journal. The report of the Zurich Bank refers, however, to a combination of European electricity companies. Remarkable as it may seem, the name of Mr. Schwab, of the American Steel Trust, has now been connected with a similar rumour afloat in Germany of the intention to form a combination of European electrical companies; but we do not believe the report will be found to have any foundation in fact. The financial crisis in the German electrical industry is beginning to settle itself by the survival of the fittest, and by the support rendered by one or more firms and their backers to others in temporary need of cash. If the Germans desired to combine their companies, they could not have chosen a more inappropriate period; but after all, the suggestion of the Zürich company may only have been prompted as a feeler, in order to ascertain the views of the trade in Germany, Switzerland, and Austria, in the hope of action being taken at a future date.

CORRESPONDENCE.

South Shields Electricity Accounts.

I was surprised to read your article *re* "Hidden Deficits at South Shields" after your editorial comment at the foot of my letter which appeared in your issue of the 15th inst. My object in writing was to correct a statement which I then said, and now repeat, is absolutely false. Surely it does not require the critical eye of an expert accountant to see whether a particular item is shown or whether it is not.

I am an engineer and was writing to an engineering paper, claiming the same right to correct a financial mis-statement as the editor of a technical journal has to insert it.

After referring to the deficits shown in the accounts for the year 1898, you say:—"In the next accounts for the year ending March 31st, 1899, no mention is made of the previous payments out of the rates." Now, if you had just taken the trouble to look on page 84 of the abstract, you would not have ventured that statement, as everything is clearly shown, and is shown in exactly the same form as at the present time, yet you say the information is at last forthcoming. I hope you will, therefore, have the courage to admit with the same candour as the editor of the *Local Government Chronicle* has done, that you have made a mistake.

I say again, emphatically and without the slightest fear of contradiction, that every deficit has been clearly shown from the commencement of the undertaking to the last published returns.

I would further add that I am not in the habit of making rash statements nor yet talking out of my hat, and can, if necessary, produce documentary evidence to prove all I say.

J. H. Cawthra,
Chief Engineer.

South Shields,
August 25th, 1902.

[The fact appears to be that we are somewhat at cross purposes with Mr. Cawthra. He is talking about the abstract of accounts published by the Corporation of South Shields, dealing generally with the finances of the borough. The *Local Government Chronicle* was speaking of the official returns to the Board of Trade, on the Board's official form, and this was the subject of our quotation from that journal. Mr. Cawthra sent us a copy of the above-named local accounts, to which we referred in our footnote to his letter; but on further investigating the matter, we found, *as we stated last week*, that the official returns are framed as stated in our contemporary. We have re-examined the official copy of the accounts for the year ending March 31st, 1899, and find that, though in the net revenue account there is an amount of £1,165 19s. as contributed from the General District Rate, no return is made of previous payments out of the rates. The accounts before us are made out upon the Board of Trade form, such as is supplied to anyone who applies for a statement of the accounts, on payment of 1s., according to the Act.—Eds. Elec. Rev.]

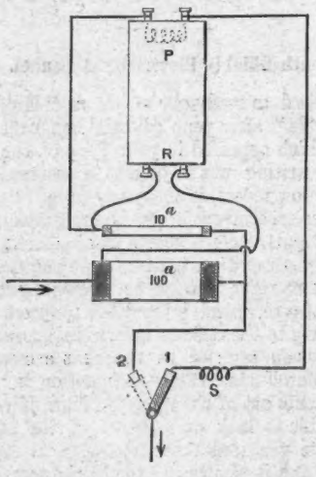
D

The Earthing of the Middle Conductor.

In his interesting article on the above subject in the current number of the Electrical Review, Mr. Abraham suggests an arrangement whereby a continuous record of the current flowing to earth may be obtained by means of an automatic switch and two shunts to a recorder.

In this connection, we think that a diagram of an arrangement for the same purpose, which has been in use for over a year at the Chesterfield tramways station, may be of some interest.

Mr. Abraham suggests that, upon hearing a bell ring, the attendant should change the pen on the recorder, so as to give, say, a red instead of a black record. In the arrangement illustrated, the recorder R (which is otherwise of our standard central station type) is provided with an auxiliary pen, which is normally held off the paper by the electromagnet P. Should the current at any time exceed 10 amperes, the switch S is released, and flies from contact 1 to contact 2, so that the circuit P is opened, and at the same



time the 10-ampere shunt is cut out of the circuit. The auxiliary pen is thereby released, and so traces a continuous straight line along the edge of the paper, which forms a permanent indication on the chart that the constant has been changed from 1 to 10.

The record is thus not only continuous, but also automatic, which is of the utmost importance, as in nine cases out of ten the attendant would be sure to omit to change the pens. It is, of course, easy, should it be thought desirable, to cause the switch to ring a bell or light a lamp, as preferred, so as to give warning that the 10-ampere limit has been exceeded.

We quite agree with Mr. Abraham that some such device should always be employed, so as to *continuously* record the leakage current.

Everett, Edgcumbe & Co.

London, E.C.,
August 25th, 1902.

I have read the articles which recently appeared in your paper on the subject of "Earthing," and in connection with this subject I have just been shown a device which I feel sure will be of interest to all central station engineers and others who have to deal with lead-covered cables or cables run in metal tubing. This device is an invention by Mr. A. J. Beaumont, of York, and I anticipate will shortly be placed on the market; it is claimed for it that by its use should a leakage beyond any predetermined limit at any time occur, the current would be immediately and automatically cut off, thus reducing the danger from fire to a minimum. It should thus be a boon to the insurance offices as well as to wiring contractors.

Joseph C. Stevens.

York, *August 26th*, 1902.

Transmission of Electrical Disturbances.

Your correspondent is in error in stating that I wonder why Hertzian waves can pass round a globe. In the first place, I have not been discussing Hertzian waves at all, but the transmission of electrical disturbances round a globe, and so far from wondering at the possibility of doing so, a reference to my notes will show that I hold it is possible to transmit signals from one point on a globe to any other point.

And even with the aid of diffraction I cannot admit that any waves akin or similar to light waves could carry a disturbance from pole to pole of a globe; besides, "diffraction" implies a "diffractor," which Mr. Sexton loses sight of. My notes referred to a theory for explaining Marconi's results, based upon disturbances in the electrical state of a globe insulated in space, without reference to Hertzian waves, further than to state my disbelief in waves like light carrying signals round a globe.

All the same, an explanation by Mr. Sexton as to what diffracts the Hertzian waves, and how they can be diffracted in passing across space, would no doubt be interesting.

R. Kennedy.

Leeds, *August 25th*, 1902.

Railway Signals.

I have read with considerable interest the paragraph contained in the "Electric Light and Power Notes" of your valuable issue of 15th inst. respecting the two sad accidents which have occurred at Gear Junction, west of Newport Tunnel, brought about by the necessity for relighting signal lamps which had accidentally become extinguished. The suggestion in regard to the substitution of electricity for oil at these signals (and presumably the whole of the others in close proximity to them, at any rate) seems to me to be a very good one so far as it goes, inasmuch as the signal lights could then be ignited and extinguished by means of a switch in the nearest signal box, regulating the supply or stoppage of the current as required, this obviating the necessity for a man having to traverse the line.

It should, however, be particularly observed that both of the accidents to which reference is made were not, apparently, experienced in the ordinary routine of lighting up, cleaning, &c., but in giving attention to failures on the spur of the moment. A lampman, when attending to signals, goes through a very similar routine every day, and consequently is well acquainted with the train service and other details of the working at those times, but the circumstance is slightly altered in the case of a failure of a lamp occurring in the middle of the night, when in all probability the regular lampman is not on duty, and the most handy man is sent off to give the requisite attention.

Decidedly, electricity would be very convenient for lighting up and extinguishing operations, if such a system were to be adopted, but for all that, the possibility of failures occurring in the night-time would still exist, and in my opinion, to an equal, if not even greater degree than at present, and it is, of course, possible for a wholesale failure of the supply to happen. This would make matters worse than they are now, as with oil lighting, each lamp is altogether independent of the others, the illuminant being, so to speak, self-contained.

In the case of a failure of the main supply, the switch without the current would be of very little use as regards the restoration of the light, just as in the case of a single electric lamp going out (due, for instance, to the deflagration of a fuse, and, alas, fuses do deflagrate sometimes), when it should be noted that it would still be necessary for someone to go, there and then, to attend the defect. This point appears to have been missed.

Apart from these considerations, there is what I take to be the unquestionable increase in the cost of electric lighting over oil, which increments railway companies in these days are so loth to consider.

It would, of course, be quite possible to almost eliminate, or at all events, greatly minimise the liability of failure by providing two electric lamps, each on a separate

main, at each signal, so that in the case of one becoming faulty, the other could be switched on. Here, however, is a duplication involving still further expense.

Signals.

August 25th, 1902.

Wireless Telegraphy.

As distinct signals by wireless telegraph can be sent over the Atlantic, I suggest that from Greenwich or other observatories, time signals might be sent to ships at sea, thus enabling them to correct their chronometers for longitude observations. At 1 p.m. a time ball is dropped at Greenwich and at Deal by electricity for the benefit of ships in the Thames and the Downs, and the systems might be extended to vessels at sea. International regulations would preserve the signals from interruption by other wireless signals. At stated times a short series of signals at intervals of a second would probably serve the purpose. They would also be useful for inland clocks, as railway time is Greenwich time.

J. Munro.

Croydon, *August 25th*, 1902.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"P. H. W." writes:—"We should be glad if you could give us information on the following question:—If a borough electric supply state that they will supply current for power use at the special rate of 2d. per B.O.T. unit, with no restrictions, would a consumer have the right to drive a motor by means of this current in order to drive a dynamo to generate current to light his premises? The borough also supply current for lighting purposes at 6d. per unit, subject to rebate."

*** It is by no means an easy matter to provide an answer to the question above propounded. To take a supply of electricity ostensibly for motive purposes and "transform" it for electric lighting would seem to be *primâ facie* contrary to the spirit, if not the letter, of the arrangement with the Borough Electric Supply Company. In giving a meaning to the words "motive power" the Court would have to look to all the circumstances. It is true that, so far as the company is concerned, the current supplied by them would be used for motive purposes; but it is notorious that the reason why it is possible to grant a power supply at cheap rates is that motors used for driving machinery are chiefly at work in the daytime, when the demand for electric light is small, and when the engines at the generating stations are running their heads off. Our correspondent states that the special rate is granted "without restrictions"; but we anticipate that these words imply that there shall be no restriction as to quantity or time of use. Upon the whole we are inclined to think that taking the words "motive power" in their natural and ordinary sense, the Court would hold the Borough Council discharged from any obligation to supply electricity at 2d. a unit for the purpose mentioned. In any event, before our correspondents lay down plant for the purpose, we would recommend them to ascertain the views of the Borough Council!

"Competitor" writes:—"I am proposing to commence business as a wiring contractor, in a district where most of the wiring is now done by the supply company, who are working under a provisional order granted two years ago. Their wiring rules are rather strict, and amongst other things they demand:—

"1. That samples of all materials used must be deposited with them, and that a contractor must not use a new maker's switch or lampholder without their permission, and that one must in each case deposit a sample.

"2. That when making extensions to consumers who are lighting, say, one or two lamps, the contractor must report in full to them before commencing.

"At present they supply 220 volts. When a contractor undertakes a job, he is informed that he must wire on two distinct and separate circuits throughout, and balance lights evenly, so that some day they may put on 440 volts. I shall be glad to know whether they can enforce any of these rules."

*** In considering any rules made by an electric supply company, who are working under a provisional order, it is well to recollect that they are bound to furnish a supply to every consumer in their district without favour to anyone.

With regard to the first of the rules above referred to, it is provided by Sec. 18 of the Electric Lighting Act, 1882 (45 and 46 Vict., c. 56), that undertakers shall not be entitled to prescribe any special form of lamp or burner to be used by any company or person, or in any way to control or interfere with the manner in which electricity supplied by them under this Act, and any license order or special Act, is used. Provided always that no local authority, company, or person, shall be at liberty to use any form of lamp or burner, or to use the electricity supplied to them for any purposes, or to deal with it in any manner, so as to unduly or improperly interfere with the supply of electricity supplied to any other local authority, company, or person by the undertakers. Differences to be settled by arbitration.

In view of this section, we do not see anything in either of the first two rules to which our attention is drawn to which a contractor, acting on behalf of the consumer, could reasonably object, and we think, moreover, that they could be enforced by the company refusing to supply electricity unless due notice was taken of them.

With regard to the rule providing that the contractor acting for the consumer shall lay two sets of wires, we cannot see any justification for this, nor do we see how it could be enforced if the consumer were to demand a supply at the lower pressure.

"Anxious" writes:—"We have two factories, one on each side of a public street. It is our intention to supply current across the street by means of an overhead cable. What course shall we have to take in the matter? Is any consent necessary from the local authorities, and what department of the said authority would deal with the matter? We believe the Electric Lighting Department have no provisional order, except that owned by the company whom they bought out."

*** We assume that our correspondent's premises are situated in a provincial town. If they were working under a provisional order, they would have to obtain the consent of the local authority to the erection of the line in question. We do not see that our correspondents need obtain such consent in the present case, unless, indeed, the local authority own the soil of the highway over which it is proposed to stretch the line. If this is so (and we might point out that it is rarely the case), the stretching of a wire is a technical trespass which may be restrained by injunction. It is provided by Sec. 4 of the Electric Lighting Act, 1888, that in case of electric lines laid across any street, rules published by the Board of Trade must be observed. Those rules provide (*inter alia*) that an aerial line shall not in any part thereof be at a less height from the ground than 18 ft., or where it crosses a street 30 ft., or within 5 ft. measured horizontally, or 7 ft. measured vertically from any building or erection other than a support for the line, except where brought into a building for the purpose of supply. It is also provided by Rule 24 that where an aerial line crosses a street, the angle between the line and the direction of the street at the place of crossing shall not be less than 60°, and the spans shall be as short as possible.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug. 27th, 1901.		Week ending Aug. 26th, 1902.	
Alexandria. Teleg. mat.	Value £75	Adelaide	Value £233
Amsterdam	80	Aden. Teleg. mat.	173
Beira. Teleg. mat.	142	Amsterdam	65
Calcutta	408	Antwerp	42
Cape Town	790	Auckland	67
Christchurch	12	Bombay	265
Christiania	24	,, Teleg. wire	511
Copenhagen	300	Buenos Ayres.	122
,, Elec. lighting cable	3,040	Calcutta	939
,, Teleg. wire	19	,, Teleg. wire	2,475
Durban	247	Cape Town. Teleg wire ..	1,150
Fremantle	224	Chinde	21
Ghent	3	Colombo	53
Gibraltar	25	,, Teleg. mat.	30
Hong Kong	10	Copenhagen	66
Nagasaki. Teleg. cable ..	5,701	,, Elec. cable	428
New York	56	,, Teleg. wire	83
Perth	476	Durban	810
,, Teleg. cable ..	5,370	,, Teleg. mat.	865
Port Elizabeth	44	Ghent	35
Rio de Janeiro	23	Gibraltar	20
,, Teleg. mat. ..	166	Laracho	101
Rodrigues. Teleg. cable	580,575	Madras	69
,, Teleg. mat. ..	119	New York	25
Santos	79	Perth	295
Singapore	25	Port Elizabeth	154
,, Teleph. mat. ..	57	Shanghai	92
Stockholm. Teleg. wire ..	60	Singapore Teleg. cable ..	73
Sydney	480	Sydney	189
Tokio	49	Wellington	810
Valparaiso	93	Yokohama	330
Wellington	17		
Total ..	£103,688	Total ..	£10,060

Foreign Goods Transhipped.

Antwerp. Elec. apparatus	Value £300	Durban. Teleg. wire	Value £147
Baltimore. Elec. machinery ..	800	Shanghai. 116 lds Teleg. poles	—
Colombo. Elec. mat.	10		
Hamburg. Elec. goods	170		
Rio de Janeiro. Teleg. wire ..	860		
Total ..	£2,140	Total	£147

Battery Contract.—An order has been placed with Messrs. Pritchetts & Gold, Ltd., Feltham, for a storage battery for Messrs. Willans & Robinson's new power house at their Victoria Works, Rugby, of 1,600 ampere-hours' capacity.

Trolley Wire Safety Device.—We illustrate herewith a simple and ingenious device for the prevention of accidents from falling trolley or telephone wires, the invention of Mr. Frank G. Evans, of Worcester, and called an "automatic self-adjusting

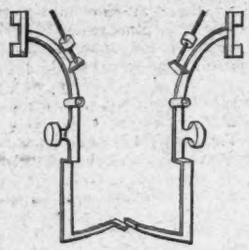


Fig. 1.

circuit-breaker." The device is fitted in the feeder pillars, and consists of two pivotted levers, held in an upright position when the current is on by two magnets with shunt coils. In the event of a trolley wire breaking, the lever on that section is instantly released, and, falling over, makes contact by a bridge-piece between the faulty section and "earth," which blows the fuse and cuts it out.

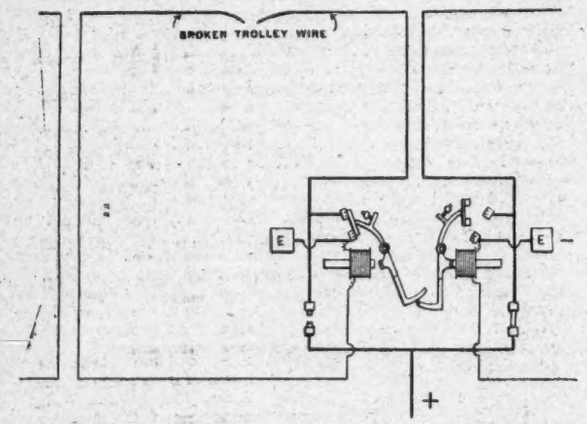


Fig. 2.

These levers are so shaped that, should a right-hand section break just after a left-hand one, or *vice versâ*, the second one is free to operate after the first one. This will be understood from fig. 1, which shows the construction of the pivotted levers. The great advantage claimed for this device is that, while operating instantly in the event of a breakage of one or both sections of trolley line, it does

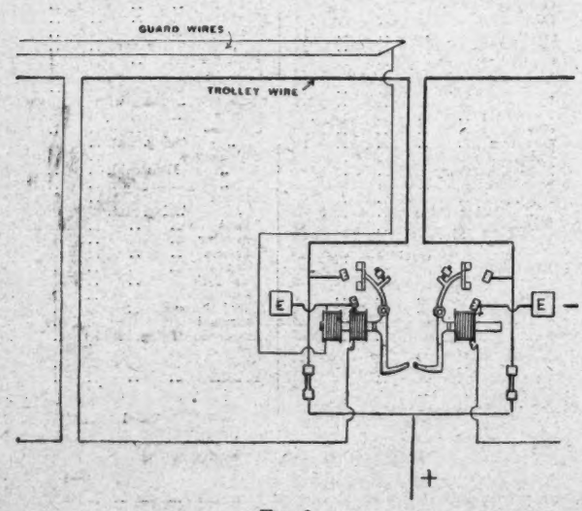


Fig. 3.

not operate when the current is cut off at the source of supply, as at the end of a run, or for other reasons, because when the current is cut off at the section pillar or station, both these levers are released at the same instant, and, after a slight movement, engage with each other, remaining in such a position as to be readily attracted and returned to their normal position when the current is again switched on at the source of supply. Fig. 2 shows the mode of connecting, also the left-hand section broken and cut out. It will be seen that the instrument requires no attention whatever when once installed. To enable the instrument to deal with falling telephone or other wires, an additional coil of the same ampere-turns as the shunt coil, but wound differentially, is placed on the same magnet, as in fig. 3; the guard wires are "earthed" through this additional coil, and should telephone or other wires fall across the trolley line and guard wires, and come in contact with them, the current flowing through the additional coil causes an equal, but opposing effect to the shunt coil. The magnet becoming dead releases the lever, which operates in the usual way. We understand that the patent is for disposal, and any communication respecting it should be made to Mr. B. H. Jenkinson, consulting engineer, 18, Crouch Hall Road, Crouch End, N., who has the matter in hand.

The Shah's Visit to the Maxim Electrical Works.—On Thursday, August 21st, his Majesty the Shah paid a visit to the works of the Sir Hiram Maxim Electrical and Engineering Co., Ltd., at Gillingham Street, and during his stay of more than an hour proved himself to be a man of great intelligence, thoroughly alive to the importance of up-to-date appliances and capable of quickly grasping the fundamental facts in everything he was shown. He was received by Sir Hiram Maxim, Mr. Jules de Meray, chairman, Mr. Thomas Wood, vice-chairman of the company, and Lieutenant Dawson, director of Vickers, Sons & Maxim. Mr. de Meray, in thanking the Shah for his visit, assured him that he would see a most interesting branch of British industry. To facilitate matters, Mr. A. W. Hill, manager of the works, had prepared a case showing every stage in the manufacture of an incandescent lamp. After this was explained to his Majesty, he visited each of the departments, and nothing seemed to give him greater pleasure or to excite his curiosity more than the new treating process which has quite recently been established at the works; Sir Hiram Maxim had to answer numerous scientific questions in connection with this operation. From the treating department his Majesty made his way to the depositing department and witnessed this operation, which, although requiring the utmost accuracy, is rendered extremely simple on the machines here inspected. The Shah and his suite next visited the blow room, and witnessed the sealing of filaments in the bulbs; they seemed greatly struck with the extreme rapidity with which this was performed by the large number of girls at work. Visits were also paid to the plastering, testing, sand-blasting and other processes, and, finally, his Majesty was biographed working a Maxim gun, from which he fired 300 rounds, this being one of five guns sent from the works of Vickers, Sons & Maxim, of Erith.

Natal Electrical Imports.—The Natal Government *Gazette* says that electrical fittings to the value of £24,235 were imported into the Colony during the six months ending June 30th, 1902, against £30,646 worth during the corresponding period of 1901. For the first six months of the present year, the value of the electrical machinery imported into Natal is officially stated to have been £37,347.

Ferranti Switchgear for South Africa.—Messrs. Ferranti, Limited, have obtained an introduction with their standard switchgear into the Orange River Colony. The Bloemfontein Corporation has ordered a complete central station switchboard to the specification of Mr. Robert Hammond, and Messrs. Ferranti are supplying the gear designed on their well-known cellular pattern. The system is a three-phase one, generating currents at 2,200 volts pressure. The field which is opening out in South Africa will be considerably extended in the future, and we are pleased to learn that the firm is about to become a pioneer of the industry in this Colony.

Gilbert Arc Lamps.—The Gilbert Arc Lamp Company, Limited, of Chingford, is very busy just now, and amongst other work is carrying out the lighting of Eastbourne, Mansfield, Kingston, Willesden, Eccles, Salisbury Station for the L.S.W. Railway (about 100 lamps), a second contract for Grimsby, a second contract for Eastbourne of alternating arcs in series, and moving coil transformers, which will be placed in pits by the circuits, as the company has already arranged them at Harrogate, Newport (I. of W.), &c. It is also doing considerable work with yellow arcs. Amongst the novelties the company has brought out this year are —raising gear, a special design of reliable automatic cut-out for arc lamps, and a new automatic switch for switching on and off the incandescents on arc lamp-posts by means of the arc lamp circuit. The last mentioned arrangement involves an entirely new mechanical device for performing two opposite operations at will.

Spain.—La Compania Fabril de Carbones Electricas is the name of a company which has just been formed at Barcelona with a capital of £80,000, to establish and carry on works at San Vicente de Casiellet (Province of Barcelona) for the manufacture of carbons for arc lamps and batteries.

Catalogues.—Messrs. T. & T. Vicars, of 20, Bucklersbury, E.C., and Earlstown, have published an excellent new list of their well-known mechanical stokers. Sectional views show clearly the principle of the device and its application to ordinary boilers, also to the Marshall-Gainsborough water-tube boiler. A description and a good deal of general data of interest to engineers are included, and numerous photographic illustrations appear of boiler rooms in electric light, tramway, and other power stations where the Vicars stokers are at work. We understand that the firm has now on its books, or has just about completed, the

following orders:—For the Great Northern & City Railway, 20 machines; Aston Manor Electric Lighting Station, 10 machines; Dudley Electric Lighting Station, 4 machines (repeat order); Cardiff Electric Lighting Station, 14 machines, with conveying plant (worm type), including repeat order; Nottingham Electric Lighting Station, 16 machines, with conveying plant (worm and belt type); Liverpool Overhead Railway, 2 machines, with conveying plant (worm type), repeat order; British Insulated Wire Company's works, 2 machines, (repeat order); Bristol Water Works, 12 machines, with conveying plant (worm type); Stobhill Asylum, 10 machines; North British Rubber Company, 10 machines, repeat order, with conveying plant (worm type); Portsmouth Electric Lighting Station, 8 machines, repeat order, with conveying plant (belt type), fifth repeat order; Antwerp Trams, 12 machines, with conveying plant (worm type); Plymouth Electricity Station, 4 machines, second repeat order; Fulham Electric Lighting Station, 6 machines, repeat order. Many other orders are in hand for large concerns for both natural and forced draught machines, and conversion of old type machines to forced draught, including repeat orders for over 90 machines.

Messrs. Joseph Tomey & Sons, Limited, of Birmingham, have sent us lists of their improved needle lubricators, "Triplex" magnifying gauge glasses, and telescopic gauge glass protectors.

The Fairbanks Company, of 78 and 80, City Road, E.C., have issued a little table for converting American dollars into English pounds, which they are publishing at a price of 6d. each. Firms having business relations with America are obliged to refer to American catalogues and price lists, and this table is especially designed for convenience in such reference. The Fairbanks Company has included a few notes on the metric system. In the belief that many people are deterred from using the metric system by the large number of unnecessary units which are ordinarily referred to, the publishers have embodied only those which are actually used in commerce, and have added simple rules for converting metric into English measures and weights.

We have received from Messrs. Johnson & Phillips, of Old Charlton, Kent, their new price lists of hot wire, iron-cased permanent magnet moving-coil and iron-cased electro-magnetic ammeters and voltmeters. Much useful information is given respecting their well-known instruments. List E.M. is devoted to electro-magnetic ammeters and voltmeters in iron cases for continuous and alternating current: list P.M. deals with permanent magnet moving-coil ammeters and voltmeters in iron cases, and list H.W. with hot wire ammeters and voltmeters, switchboard and portable types.

The Union Electric Company, Limited, of Queen Victoria Street, E.C., has just issued a pamphlet, No. 1,001, in which particulars are given of "Union" new standard dynamos and motors for industrial purposes. The pamphlet is one of 10, setting out the advantages and varieties of the V-type machine. The dynamos are usually constructed of the open type, but can be also made enclosed or enclosed and ventilated in the same way as the motors. The company claim for their enclosed ventilated type of motor that it has such efficient ventilation, both through the armature by many channels and over the commutator, that it is able to be rated as highly as the open-type motor. Another advantage claimed for this machine, and covered by a patent, is the adjustable pole-pieces, enabling the brushes to have a fixed position as regards the machine, the adjustment being permanently made in the factory by means of the adjustable laminated pole shoes.

Messrs. T. F. Welch & Co. of Boston., U.S.A., have sent us a price list of their hardware and tools, gears and gear-cutting.

The Taunton Locomotive Manufacturing Co, of Taunton, Mass., U.S.A, are makers of snow-ploughs and sweepers for railway and tramway service, and illustrated lists thereof are in circulation, also of the Wainwright surface condenser, feed heaters, electric locomotives, transfer tables for double-truck cars, street sprinklers, &c.

A list of the Zodel-Voith patent flexible insulating belt coupling has been brought out by Messrs. Bergtheil & Young, of Camomile Street, E.C.

A batch of circulars relating to telpher lines and their construction, has been sent to us by the United Telpherage Co, of New York.

Mr. Wilmot North, of St. Mary's Road, Sheffield, who is the sole agent in this country for the Benskin Manufacturing Company, of America, has sent us lists and a specimen of that firm's "Perfect" leather and wood fillets for pattern-making. The leather fillet is claimed to be simple and effective, a slight pressure of the finger fastening it in place on the most difficult curves, angles, &c. The obtuse angle wood fillet is made from best pine by a special process, and it is made with a slight bevel to fit taper on patterns, thus ensuring perfect edges. It is sold in 4 ft. lengths. It is claimed that the use of the "Perfect" fillets produces a great saving in labour as compared with the old style, and that the sand leaves them as clean as any other part of the pattern. Mr. North also supplies tools for working the fillets. He has issued another list in which his machine-cut and machine-moulded wheels are shown.

The General Electric Company (1900), Limited, in its August "progress" sheet details a number of its small specialities, such as motor switches, lampholders, glass shades; another list describes Wood's patent combined water-cart, rail-cleaner, and snow-sweeper.

Bankruptcy Proceeding.—A receiving order has been made on debtors' petition, against W. Morton and W. T. Sampson, (Morton and Sampson, electrical and mechanical engineers, of Chester and Warrington).

Dissolutions and Liquidations.—A meeting of the British Thomson-Houston, Ltd. (old company), will be held at 69, Cannon Street, E.C., to hear an account of the winding-up by the liquidator, Mr. James Devonshire.

December 1st has been fixed as the date for lodging creditors' claims, &c., in *re* D. Stewart & Co., Ltd. (in liquidation). Liquidator, R. H. Ballantine, 116, Hope Street, Glasgow.

Messrs. C. W. Webster, A. L. Rhodes and S. W. England (Rhodes and Webster, City Electrical Works, Paradise Street, Bradford) have dissolved partnership. Messrs. Rhodes and England attend to debts.

Creditors of the Coley Electric Works, Ltd. (in liquidation), must send particulars of their claims to S. W. Oakley, 4, King Street, Cheapside, (the liquidator), by September 22nd.

Messrs. J. A. Bauer & L. E. Schramm (Electrical and General Engineering Co., 17, Gracechurch Street, E.C.), have dissolved partnership. Mr. Bauer will continue the business under the old style.

Books Received.—"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." Session 1901—02, Vol. xviii. London and Newcastle: Andrew Reid & Co, and the Institution.

"Calendar of the Glasgow and West of Scotland Technical College." Session 1902—03. Glasgow: Glasgow and West of Scotland Technical College.

"Induction Coils for Amateurs," edited by Percival Marshall. London: Dawbarn & Ward. 6d. net.

"Text-Book of Electro-Chemistry," by S. Arrhenius. Translated by John McCrae. London: Longmans, Green & Co., 1902. 9s. 6d. net.

"Science Abstracts," No. 56, August 25th, 1902. London Feilden Publishing Company, Limited. 2s.

"Electric Traction," by J. W. Meares. Calcutta: Bengal Secretariat Press, 1902. Rs. 1—8, or 2s. 3d.

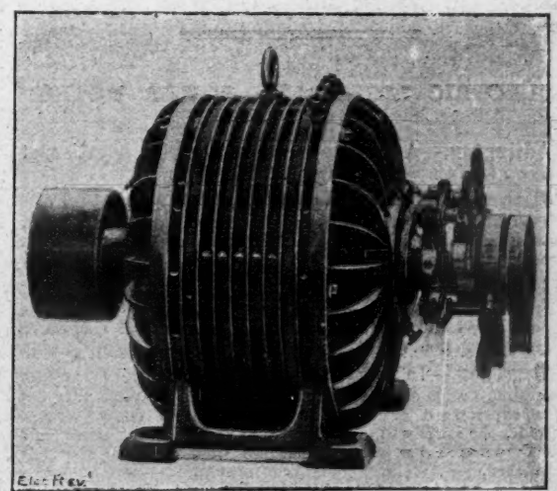
"The Potash Salts," by Dr. Lorentz Albert Groth. London: The Lombard Press, Limited, 1902.

"General Reports of H.M. Inspectors on Science and Art Schools and Classes and Evening Schools, and of Examiners in Science and Art for the Year 1901," and "General Reports of H.M. Inspectors on Elementary Schools and Training Colleges for the Year 1901." London: Eyre & Spottiswoode, 1902. 5½d. and 1s. respectively.

"Modern Iron Foundry Practice," Part I., by Geo. R Bale. London and Manchester: The Technical Publishing Co., Ltd., 1902. 5s. net.

"Journal of the Institution of Electrical Engineers," Vol. 31, part 6, and Index. List of officers and members. London: E. & F. N. Spon, Ltd. 2s.

De Grelle Induction Motor.—A new type of asynchronous alternating current motor is being placed on the market by Messrs. De Grelle, Houdret & Co., 130, London Wall. This motor has a ribbed case, instead of a smooth cylindrical case as generally used, ensuring perfect air cooling and consequently low temperature of the motor. The motors are lighter in weight, and, at the same time, possess great strength from the manner in which the ribs are secured. Automatic oiling arrangements are fitted to all bearings. The motors are built for one, two, and three-phase, 40 to 60-period circuits, 100 or 200 volts, from ¼th to 50 H.P. The makers guarantee a higher efficiency with this type of motor than it is possible to obtain with the smooth cylindrical-cased motors now in use. Toothed gear is fitted to the motors for speed reduction when required.



De Grelle Induction Motor.

New Book.—Messrs. Whittaker & Co. will publish shortly a work on "Galvanic Batteries," by Mr. S. R. Bottone. This book will

treat of the theory, construction, and use of electric batteries, comprising primary, single and double fluid cells, gas and secondary batteries, and will contain numerous illustrations.

York United Gas Light Company v. British Power, Traction, and Lighting Company, Limited.—At York Police Court on Monday, the York United Gas Light Company sued the British Power, Traction, and Lighting Company, Limited, for £82 11s. 9d. due for gas supplied to the defendants' works at Hull Road, York. The debt was not disputed, but objection was taken to the jurisdiction of the Court, and to two shareholders in the Gas Company adjudicating in the case. In the end, the defendant company's solicitor consented to a distress warrant being issued for the sum claimed.

Trade Announcements.—The Lister Electric Manufacturing Company, of Dursley, Gloucestershire, is about to be converted into a private limited company, and Mr. G. Del Revo, who has been associated for a number of years with Messrs. Ferranti, of Hollinwood, is joining the board of directors as managing director. The board will consist of Mr. G. and Mr. J. F. Lister (who have been associated with the business of the company since its commencement), and Mr. G. Del Revo. The company are making important additions to their works, and are laying down additional special plant to meet the increasing demand for the Lister C C dynamos and motors. They are also at an early date putting a standard line of polyphase motors of an improved design on the market.

We are informed that the business of the "Standard" Electrical Engineering Company is now under the sole control of Mr. Frank R. Bowyer, of Tan Bank, Wellington, Salop, who is responsible only for the completion of contracts and maintenance; Mr. G. Pierce (with whom Mr. Bowyer has been associated) attends to debts incurred previous to August 23rd, and receives payments in respect of existing contracts in Wellington and Market Drayton. Mr. Bowyer will carry on business under the same style as heretofore.

The Kent Electric Power Syndicate, Limited, have taken chambers over the London and County Bank at Chatham for their head offices.

For Sale.—The Eastbourne Corporation wants tenders for the purchase of steam engines, boilers, shafting, alternators and exciters, meters, switchboard, transformers, and other steam and electrical plant now disused owing to the construction of new works. For further particulars see advertisement pages.

The Southend Corporation wants tenders for two Davey-Paxman boilers, two small engines of the same make, and two Crompton dynamos (the pier electric generating plant). For further particulars see our advertisement pages.

Electrical Exhibition.—A Corporation electrical exhibition will be held at Grimsby on October 9th, 10th and 11th. Those who want to book space should see our advertisement pages to-day.

Pontypool.—Messrs. Alger & Son have been instructed by the local guardians to light the workhouse with electricity, the L.G.B having given their permission.

ELECTRIC LIGHT AND POWER NOTES.

Adlington.—A company has notified its intention of applying for a prov. order to supply the town.

Batley.—The T.C. proposes to utilise steam from the refuse destructor to generate current for traction and lighting, and has applied for a loan of £5,038 for the erection of the destructor alongside the electricity works.

Birkdale.—The electric light is being eagerly sought after in Birkdale, and applications for supply are so numerous, that the company has decided to lay cables and extend them wherever it is possible to do so.

Brighton.—In connection with the building of the new generating station close to the sea at Southwick, great difficulty has been experienced in finding foundations. Upon excavating test holes for the south wall, £1,200 has been spent without success, and the Corporation has decided that the work shall be definitely abandoned.

The T.C. spent some time at its meeting on August 21st, relative to orders for goods required for the electricity works being given to the Reason Manufacturing Company, Limited, Brighton. One of the members (Mr. Tozer) objected to goods being obtained from the company on the ground that it was practically ordering goods of their own servant, as Mr. Arthur Wright, the Corporation's consulting engineer, was interested in the company. The Mayor replied that even if that was true it did not matter if they got the best goods. Mr. Tozer thereupon characterised trading with the Reason Company as being illegal, but the Mayor denied this, and pointed out that Mr. Wright was not the Council's servant, he was the consulting engineer. In reply to questions as to what was Mr. Wright's position in the company, it was stated that the Mutual Electrical Trust Company were shareholders in the Reason Manufacturing Company, and Mr. Wright was, practically speaking, the proprietor of one-third of the shares in the Mutual Company. Councillor Marx said he should like to know the amount of the holding of the Mutual Company in the Reason Company, and thought that the Council should be told what was the holding of Mr. Wright in the latter concern. Alderman Lowther pointed out that the name of Mr. Wright did not appear on the list of shareholders. Mr. Tozer withdrew an assertion that Mr. Wright was head of the Reason Manufacturing Company, and suggested that he was the largest shareholder. With that the matter dropped.

Eccles.—In his annual report, the borough accountant states that the deficit on the year's working of the electric light undertaking amounts to £867 11s. 4d. This is £738 10s. 4d. less than the previous year's loss.

Ebbw Vale.—The D.C. has resolved to accept the tender of the South Wales Electrical Power Distribution Co. for the supply of energy for lighting purposes.

Frimley.—The U.D.C. has favourably considered the question of entering upon a scheme to provide electricity in the district.

Hastings.—The T.C. has applied to the L.G.B. for a loan of £644 for electric light mains extensions and a pressure-variation recording apparatus.

Heckmondwike.—Owing to the heavy premium required, the U.D.C. has decided not to insure the plant at the electric light works against breakdown or accident.

Huddersfield.—The Electricity Committee has decided to make application to the L.G.B. for sanction to borrow £5,000 for the purchase of motors and appliances for the purposes of the Huddersfield Corporation Act, 1902.

Kalgoorlie (W.A.).—The Kalgoorlie Electric Power and Lighting Corporation's plant is giving great satisfaction, and further contracts have been entered into with the Boulder Block Lighting Syndicate, the Hannan's Central Extended Gold Mining Company, and other companies for the supply of electric power.

Keighley.—The T.C. has resolved to make application to the L.G.B. for sanction to borrow £6,000 for the extension of mains and services, and the supply of motors and arc lamps on hire, viz., £750 for services, £400 for meters, £1,200 for motors, £60 for arc lamps, £3,280 for extensions of mains and 5 per cent. for contingencies.

Leeds.—While some additional coal-elevating machinery was being erected at the electricity works, the elevator fell upon a man named Hart and killed him.

Levenshulme.—The U.D.C. has received notice from the Electricity Department of the Manchester Corporation, stating that it will be in a position to supply current to the district for lighting purposes within a month.

Liverpool.—At the half-yearly meeting of the Liverpool Gas Company last week, Mr. James Lister, the chairman, said that in spite of the electric light, the consumption of gas had increased during the half year by 3 per cent., and since June last by 4¼ per cent. Therefore, instead of being in antagonism, the electric light was doing the company good. This is another instance of the curious fact, which has been observed in so many cases, that the introduction of electricity benefits the gas undertaking.

Llandudno.—Owing to the ever-increasing demand for electricity, the existing plant at the U.D.C.'s electricity works is so heavily taxed, that it has been decided to instal another dynamo and engine in a temporary building.

Gainsborough.—The Electric Supply and Traction Co. and the United Electric Light and Power Company have intimated their intentions to apply for prov. orders to supply the district within the Council's area. When similar notices were received in 1900, the Council proceeded to give notice of applying to the B of T. for its own order, but nothing was done, beyond depositing plans. It has now been decided to take steps to secure the powers.

Nantwich.—A L.G.B. inquiry into the application of the U.D.C. for loans of £12,505 for electric lighting purposes, and £1,275 for the erection of a refuse destructor, was held on August 21st.

Newton Abbot.—The Urban Electric Supply Company has offered to provide 26 100 c.p. lamps for street lighting at £975 for the first year.

St. Helens (I. of W.).—The U.D.C. is negotiating with the Isle of Wight Electric Light and Power Company for the lighting of the town by electricity. For a five years' contract the company offers to light the lamps at 50s. each per year.

Sandwich.—The T.C. has received three notices from companies of their intention to apply for prov. orders to supply the district.

Slough.—With the object of taking over from the U.D.C. its electric lighting powers for Slough and Datchet, the Windsor and Eton Electrical Installation Company has formed a company entitled the Slough and Datchet Electrical Supply Company, with a capital of £50,000.

Stafford.—The fine old church of St. Mary is to be lighted with electricity instead of gas, at a cost of £175. Messrs. Rooper are doing the work. Stafford is a place where the Corpora-

tion supplies cheap gas, and with the restricted vision characteristic of municipal traders, the Council looks askance upon its younger project; with a population of over 20,000, the plant installed has not attained to 400 KW. in six years.

Trowbridge.—The U.D.C. having received communications with respect to the leasing of the Council's powers under its prov. order, has instructed the Electricity Committee to fully consider an offer made by a company, which proposes to erect a central station at Radstock, and to supply energy in bulk to local authorities within a radius of 15 miles. The Council considers that by this scheme energy will be obtained cheaper than if it established its own works.

Uxbridge.—The R.D.C. has given consent to the Uxbridge and District Electric Supply Company to supply the parishes of Harefield, West Drayton, and Yiewsley with electric light.

Wilts and Somerset.—A scheme is on foot for the supply of electricity for lighting and motive power in Wiltshire and Somersetshire. According to the *Colliery Guardian*, a syndicate has been formed, and all the required capital obtained for erecting an extensive electrical generating station and plant at Radstock. Bristol Corporation has intimated its intention of trying to prevent the necessary powers being obtained.

From the central works cables are to be laid to towns within a 15-mile radius requiring electrical supply. Thus Trowbridge, Bradford-on-Avon, Westbury, Frome, Bath, Warminster, and possibly Melksham, Shepton Mallet, Wells, &c, will come within the scope of the new works. It is confidently anticipated that electricity can be generated and supplied at a price 50 per cent. less than it would cost a local authority to work a plant of its own.

Winsford.—The B. of T. have informed the U.D.C. that they will allow consideration of the revocation of the Council's electric lighting order to stand over until January 1st, 1903.

ELECTRIC TRACTION NOTES.

Austria.—Plans are being prepared for the construction of a system of municipal electric tramways in the town of Lemberg, application having just been made for the necessary preliminary concession.

Blackpool.—The receipts of the Corporation trams from April 1st are far from satisfactory. The takings to date amount to £20,000 (about £700 behind last year). On the promenade section there is a decrease of £1,700, and the total loss would have been greater but for the extra revenues derived from the New Road line, which was only opened this year. The falling-off is attributed to two causes, viz., the unfavourable weather and the system of fares in operation.

Bradford.—The T.C. has decided to extend its service of electric trams from the terminus at Idle to Greengate, in response to a requisition from the latter town.

Brighton.—Plans have been prepared by the borough surveyor for the extension of the electricity works at an estimated cost of £800 to accommodate the battery and reversible booster at present on order. This battery is to assist the tramway engines over the peaks of the load.

Brussels—Antwerp.—As recently announced, the Belgian Government has received an application for the concession of the proposed electric railway between Brussels and Antwerp. A further step in advance has just been made by an authorisation that has been issued to the would-be concessionnaires, Messrs. Empain Frères, to carry out the preliminary studies. This is tantamount to official recognition and approval of the project. Soundings are to be commenced without delay, and it is probable that a definite proposal will be placed before the Belgian Chamber before the end of the present year.

Bucks.—The County Council has decided not to oppose the scheme of the London United Tramways Company to extend its service of electric trams to Slough and Maidenhead, with branches to Datchet and Langley Station. Counsel, however, will be retained with the sole object of safeguarding the Council's rights with regard to the roads.

Burnley.—The Tramways Committee has recommended the T.C. to construct three additional electric tramway lines in order to complete the original scheme.

Bury.—The Tramways Committee has offered to construct a line for electric trams to Whitfield. The Whitfield U.D.C. has the option of purchasing the track and equipment at the end of 25 years.

Dewsbury.—An inquiry was held last week into an application to borrow £10,000 for an extension of generating plant for the new tramways, which are to be run by a company which is to pay 1¼d. per unit for the power. The Dewsbury people are hoping for extensions in the near future giving them complete tramway communication with Bradford, Huddersfield and Wakefield, but further powers are still necessary before this can be attained.

France.—La Compagnie du Chemin de Fer Orléans has decided to adopt electric traction on the railway between Paris and Juvisy.

Glasgow.—The Board of Trade inspector, Colonel Yorke, inspected the extension of the Corporation tramways lines to Cawtyne, Rutherglen, Cathcart and Pollokshaws last week. These extensions, it is expected, will be in full operation within the next few days.

Replying to a criticism at last week's meeting of the Town Council, the sub-convener of the Tramways Committee stated that from June, 1901, to May, 1902, there had been 22 fatal accidents on the system. The life-guard recommended by the Board of Trade had been fitted on 400 cars, and was being placed on the remainder as quickly as possible. The time tables were regulated to give an average speed of 6½ miles per hour. In no other city was the average speed less. In America where there were no speed regulations—no Board of Trade, in fact—the cars were run at any speed. The department were doing what no other city was doing, namely, fitting Newell electro-magnetic brakes to all their cars, at a cost of £20,000.

Halifax.—The T.C. has decided to allow Mr. F. Spencer, electric tramways manager, to accept an articled pupil, a privilege enjoyed by the electrical engineer (Mr. Rogerson), and the gas and borough engineers.

Huddersfield.—Whilst unable to see its way to extend the electric trams to Brighouse at present, the T.C. has expressed willingness to consult with the Mirfield U.D.C. and the B.E.T. Company with respect to an extension to Mirfield, and subject to the gradients being improved, it has been decided to apply to the B. of T. for power to construct an electric tramway to Newsome.

The borough engineer has been instructed to prepare plans, specifications, &c., for the reconstruction of three sections of tramway, and to obtain tenders for the following materials:—200 tons rails, 10 tons fishplates, 20 pairs points, and 20 crossings, 1 ton 16 cwt. 1-in. bolts and nuts, 18 cwt. ⅞-in. bolts and nuts, 150 12-ft. copper bonds, 250 tons Portland cement, 480 tons pitch, 12,000 gallons oil, 350 tons ½-in. racking, 400 tons sand, and 300 tons Lancashire setts.

Keighley.—A fortnight ago the T.C. discussed the question of a change from horse to electric traction in connection with the tramways, but as the initial outlay was estimated at something like £22,000, and such an expenditure would necessarily result in an augmentation of the rates—at present at the high figure of 10s. in the £—the proposal was defeated by 11 votes to 6. After this, Councillor Thomson gave the following notice of motion:—"That the necessary steps be taken to obtain borrowing powers for the equipment of the present tramways with electric traction, and to obtain a prov. order authorising the construction of other tramways within the borough." The Ratepayers' Association on learning of the effort to reopen the question, passed a resolution praying that the Council would reject the motion; but at the Council meeting held on Tuesday Councillor Thomson withdrew his motion. Our local correspondent says that Keighley people would favour electric tramways to-morrow were the rates not already so burdensome.

Liverpool.—The new electric tramways from the recent southern terminus of the tramways in Aigburth Vale to Garston has been completed. This length of tramways was projected by a local company, and powers for constructing it were obtained. The powers were taken over by the City Council, whose officials have constructed the line.

Liverpool—Manchester.—The prospects of the electrification of the Lancashire and Yorkshire line and of the line worked by the Midland, Great Northern and Great Central railways between Manchester and Liverpool has aroused interest in the district afresh in electrical traction and local railway matters. It is taken for granted that if the companies named electrify their Liverpool—Manchester lines, the London and North-Western will do the same. The movement towards electrification has been made in view of the early construction of the mono-rail line between Liverpool and Manchester. Electrical traction, therefore, promises to be an absorbing topic in the district, and to find much work for electrical engineers for some time to come.

Maidstone.—The Parliamentary Committee of the Kent County Council reported last week that the Maidstone Corporation's scheme for a light railway to East Barming will traverse nearly two miles of road under the jurisdiction of the County Council. The Committee recommended that the road should be widened by the promoters at all points to 24 ft.; wherever it falls below that width, and if the Corporation declines to accept a clause to this effect, the Council decided to oppose the scheme. With regard to the Crystal Palace light railway, it was reported that the scheme was open to no objection.

Melbourne (Victoria).—At the request of the Minister of Railways, Mr. Rennick, Engineer for Railway Construction, has prepared a report with a view to the establishment of electric tramways to the suburbs. He says that the time is now ripe for the extension of the tramway system, and recommends that 13 lines, aggregating 50 miles, should be constructed to start with. The overhead or trolley system he thinks the cheapest to construct. The cost for a single line per mile would be £7,000 for the lightest, and £12,000 for the heaviest. Mr. Rennick also adds that it will be necessary to convert the suburban railway system to the electric system in the near future.

Mersey Railway.—In their latest report the directors regret the continued decrease in the traffic receipts, which is due to the competition of the Birkenhead tramway system.

Motor Cars for Electrical Engineers.—The New York Edison Co. has placed orders for a number of motor cars for the use of the superintendents of the various lighting and power stations in New York and Brooklyn. Naturally, electrical motor cars have been selected, the order having been placed with the Electrical Vehicle Co., of Hartford, Conn., U.S.A.

Paisley.—Much dissatisfaction is expressed at the slowness shown with the electrification of the tramway system for which Mr. Murphy, of Dublin, obtained the provisional order.

Rhosllanerchrugog.—The construction of the first electric tramway in North Wales has been commenced by a company. The first section will run from Wrexham to Rhosllanerchrugog, and Brymbo and Coedpoeth Parish Council is making an effort to get the line extended to Brymbo.

Stirling.—The T.C. has received intimation of a private company's intention to establish a line of electric tramways between Stirling and Bannockburn shortly, provided the Council grant electric power from its supply station and assist in other ways. The Council seems to favourably entertain the idea, and has remitted to a committee to report.

Tramcar Building.—A delegate meeting of operative tramcar builders from all United Kingdom centres of the trade, lasting three days, has just been held in Manchester. The recent development of the industry and keen competition have made it desirable that uniform conditions of work should be observed. A series of regulations was adopted which the delegates hope will be found acceptable to the corporations, companies, and contractors affected. An endeavour to form a conciliation board was resolved upon, and firms are asked to adopt the Board of Trade regulations against lead poisoning.—The *Times*.

Unsworth.—The B. of T., on the advice of Major Druitt, has renewed the license to the Tramway Company to use the lines for steam power for two years from August 11th.

Wirral Railway.—At the half-yearly meeting of the Wirral Railway Company, on 25th inst., Mr. T. H. Jackson said that they were feeling the competition from the opening of electric tramways in the district, but as these brought increased population the company would expect to share in the general prosperity. They had several schemes under consideration for running the railway by electricity, but nothing had yet been decided upon. Probably they would wait to see the effect of electric traction on the Mersey Tunnel Railway, which, it was expected, would be in operation in the ensuing spring.

TELEGRAPH AND TELEPHONE NOTES

Brighton Telephones.—Last week, by 32 votes to 5, the Council adopted a municipal telephone scheme, the license for which was granted last year. A local paper details the position of matters thus:—The exchange area embraces Brighton, Shoreham, Steyning, Hurstpierpoint, Burgess Hill and Rottingdean. Hove was included, but she refuses to admit the wires. The proposal is to establish a 2,000-line exchange,—that is, to start by making provision for 2,000 subscribers. The tolls are to be £5 10s., or, alternatively, a rental of £3 10s., plus 1d. per call. The number of promised subscribers is 685, independently of 146 in Hove. The estimated expenditure is £45,000, which includes £3,000 for the installation in Hove. Tenders have been received showing that the work can be carried out well within that amount. Sanction has been asked for a loan of £45,000, but the L.G.B. refused their sanction, on account of the refusal of Hove to admit the wires. The Department asked for revised estimates with Hove cut out, and the engineer has been directed to revise them accordingly. In opposition to the contentions of Hove, it is said that the wires could be taken into Hove by the overhead system, as has been done under like conditions by the Glasgow Corporation. Brighton has already expended £3,500 in the laying of ducts beneath the tramway tracks, and has incurred large liabilities to the engineer. He considers that if the Corporation compel inhabitants to continue to pay the company £10 a year for a telephone service, when other towns are paying the municipality but £5 or £6, its policy will hereafter be characterised as "timid and shortsighted." The working expenses, including repayment of loan and interest charges, and the provision of a depreciation fund, are estimated at £10,269, against revenue from 2,000 subscribers, at an average rental of £5 5s., of £11,469, leaving a balance of profit of £1,200. Cost of construction (including engineer's fee of 5 per cent. on the outlay)—£43,461 12s. The repayment of the loan was to extend over 25 years.

Huddersfield Telephones.—At the July meeting, the Huddersfield Borough Council resolved that an agreement be entered into with the National Telephone Company for laying underground wires within the borough for a period expiring in 1911. The town clerk has since received a communication from the National Telephone Company declining to peruse the proposed agreement on the basis of a consent terminating in 1911. At the meeting of the Council on 20th inst., Alderman J. Sugden, by letter, referred to the "inglorious termination" of this question, of granting the company permission to lay underground wires, now that the Corporation has abandoned the intention of establishing a municipal telephone exchange. Alderman Sugden said that at the September meeting, he would move another resolution, to end or mend all that had been done, with the object of preventing further loss of revenue to the town.

New C.S. "Iris."—On the 21st inst., Messrs. David J. Dunlop and Co., of Inch Works, Port Glasgow, successfully launched from their yard the twin-screw cable-laying and repairing steamer *Iris*, built to the order of the Pacific Cable Board. The length of the vessel on load line is 285 ft.; breadth moulded, 40 ft. 6 in.; and depth moulded to spar deck, 25 ft., with a gross tonnage of about 2,300. The vessel has been built to Lloyd's highest class as a spar-deck steamer, and contains four cable tanks, picking-up gear forward, bow and stern sheaves, and paying-out machinery aft. There is also an electric light installation consisting of two engines and dynamos by Messrs. Wm. Harvie & Co.

Sheffield Telephones.—The Corporation proposes to apply to the Postmaster-General for a license to establish a municipal telephone system. The capital expenditure is estimated at £100,000, and the revenue at £17,000.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	..
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900	..
Trinidad-Demerara No. 1	Aug. 27, 1901	..
Communication with Bolama	April 18, 1902	..
St. Lucia-St. Vincent	May 8, 1902	..
St. Lucia-Grenada	May 8, 1902	..
Dominica-Martinique	May 8, 1902	..
St. Lucia-Martinique	May 8, 1902	..
Guadeloupe-Martinique	May 9, 1902	..
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902	..
Puerto Plata-Martinique	July 10, 1902	..
Guantanamo-Mole St. Nicholas	Aug. 5, 1902	..
Nagasaki-Fusan (between Tsushima and Fusan)	Aug. 5, 1902	August 21
Cape Town-Mossamedes	Aug. 15, 1902	August 24
Cayenne-Pinheiro	Aug. 13, 1902	..
Landlines :—		
Route *via* Hanekin on Persian territory	Feb. 24, 1900	..
Communication with Tientsin and Taku *via* Helampo	July 18, 1900	..
Communication with Juneau, Alaska	Aug. 13, 1902	..
All lines between Blagowestchensk-Wladiwostock (Siberia)	Aug. 22, 1902	August 23

Underground Telegraph Cables.—Mr. Austen Chamberlain, the new Postmaster-General, has informed the Glasgow Chamber of Commerce, that he will not lose sight of the importance of laying an underground telegraph cable between London and Scotland.

Wireless Telegraphy.—New York *Electricity* of August 13th says that papers have been served by the De Forest Wireless Telegraph Company on the Marconi Wireless Telegraph Company, of America, and the firm of E. Rollins Morse & Brother, its financial agents, to appear in a damage suit to recover $1,000,000, the extent of injuries claimed to have been inflicted by the Marconi Company through its alleged publication of an article in a New York daily newspaper. This article stated in substance that the Marconi Company, one of the present defendants, was bringing an action against the De Forest Company for the infringement of the patent rights in America of the Marconi service, and went on to say that the Marconi system would legally stand against all others, none of the three foreign systems having been patented in America, and the single American company (the De Forest) holding patent rights which would, it said, expire next year. The De Forest people assert that the article is false, as no action was pending against them, that the De Forest patents are unimpeachable, and that the Marconi people "maliciously, and with intent to injure the plaintiff in its business, caused the article as above set forth in the said newspaper, and the substance thereof, to be reproduced in various other newspapers of general circulation throughout the United States of America and foreign countries."

The *Daily Mail* Paris correspondent says that a wireless telegraph station will shortly be erected at the Auderville lighthouse, near Cherbourg, at a cost of £3,000. The station is expected to be of great service to the steamship companies making Cherbourg a port of call.

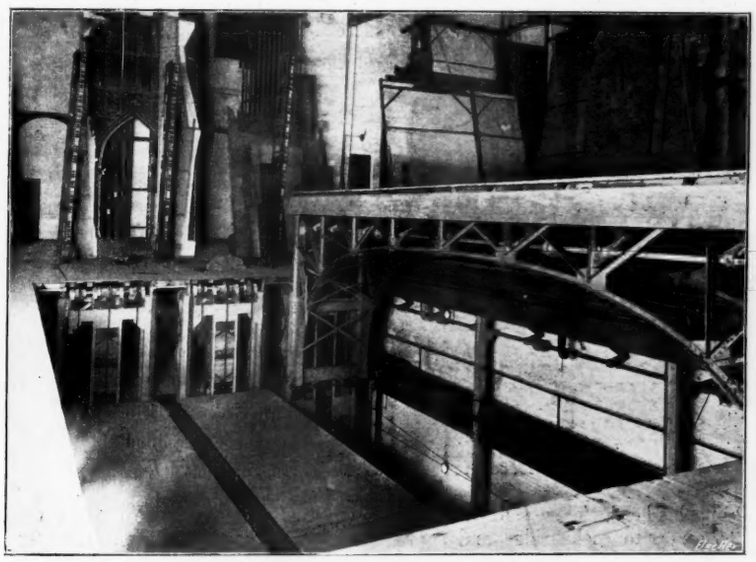
It is reported from Ottawa that the Department of Public Works is despatching an official to Anticosti to initiate the building of a series of Marconi wireless telegraphy stations.

Wireless Telephony.—Reuter's agent at Sassnitz says that on Sunday morning the first messages were exchanged by wireless telegraphy and wireless telephony between the stations of Sassnitz and Kolberg, which are 170 kilometres apart, and which were erected by the Siemens-Halske Electrical Company, of Berlin, for experimental purposes.

(Continued on page 352.)

ELECTRICITY AT THE COVENT GARDEN OPERA HOUSE.

The application of electric power belongs to the more recent innovations of stageland, and as far as we are aware, its introduction has so far only been undertaken in two cases, namely, at the Theatre Royal, Drury Lane, and at the Royal Opera House, Covent Garden. In both these cases electric power was introduced at the instance of Mr. Edwin O. Sachs, in connection with his patent system of "bridges." The Royal Opera House also makes use of electric power for some of its hoists and for the fans in its ventilation scheme. The Opera House is thus the first theatre in which electricity has really been applied to the full extent, in accordance with modern ideas.



View of Bridges; One Raised, Two Lowered.

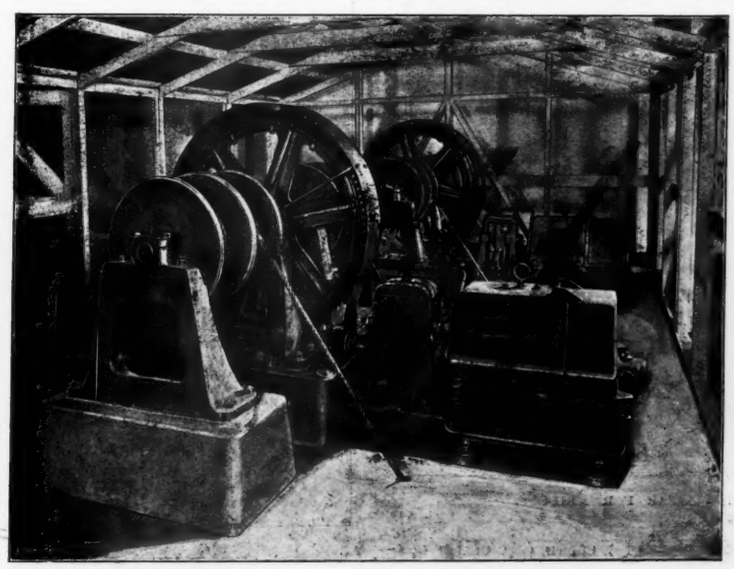
An entirely new stage equipment has been provided on modern lines, everything above the stage being now worked on the Brandt patent counterweight system, and everything below it on Sachs's patent electrical bridge system.

The stage may be described as comprising a series of six horizontal sections running parallel with the curtain line from front to back, each section being 8 ft. wide, and the whole being followed by a large back or rear stage. The first section contains nothing but a plain "carpet cut," and openings to take the old-fashioned "grave" trap, "star" trap, or other similar contrivances. The second and third sections comprise large bridges, which can be raised 6 ft. above the stage, or lowered 8 ft. below the stage, constructed in two levels, on the lower of which appliances can be installed for the purpose of raising minor platforms above stage level, or sinking traps and the like. The fourth, fifth, and sixth sections consist of large bridges running right across the stage front, which can be raised 9 ft. above the stage, or lowered 8 ft. below. The back stage has no openings or mechanism, beyond certain trap doors to a scenery store and the necessary electrical mechanism for raising and lowering scenery for storage purposes.

Between the various sections of the stage, long longitudinal flaps, 2 ft. wide, have been formed, and these can be easily opened to allow scenery to be passed through below for transformation scenes and the like. Each section is equipped with what is termed a pair of chariots, to hold "wing" lights placed on so-called "wing" ladders.

All the electrical bridges are worked from the "mezzanine" level with ordinary switchboards, and can be raised and lowered at various speeds, taking loads up to 2 tons.

Above the stage level, each section has its series of lines to take "cloths," borders, &c. Each section has a batten, from which the electric battens are suspended, and a large wooden lattice girder, from which heavy pieces of scenery can be suspended.



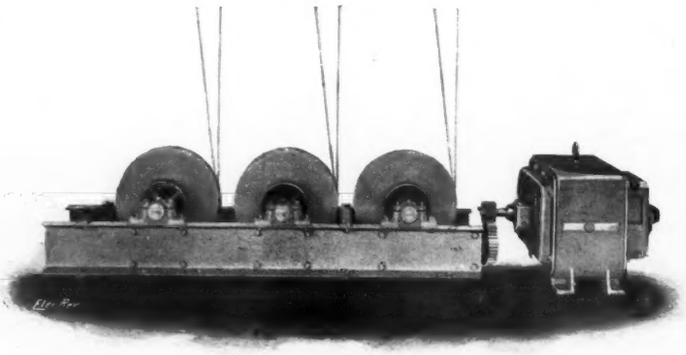
Motors and Gear for Operating the Bridges.

Throughout the structure and mechanism steel has been used, iron pulleys and wire cable, and the inflammable materials have been reduced to the minimum; seeing that the electric light has been installed, the risk of an outbreak of fire or of its spread has been materially reduced

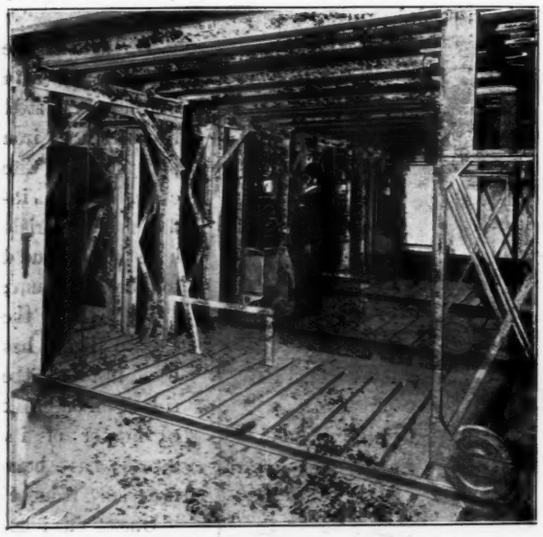
One of our illustrations shows the "bridges" at work, bridges Nos. 3 and 4 having been lowered 8 ft. below stage level, and bridge No. 5 raised 6 ft. above stage level. In the illustration the counterweights, which take up a large proportion of the load of each bridge, are distinctly visible. Another view shows two of the motors with winding gear for raising the bridges. These appliances are placed at

the cellar level directly below the bridges which they work; each motor set is entirely independent and complete in itself. Power is supplied at 200 volts to four-pole enclosed motors, which are shunt-wound, and develop from 7 to 10 B.H.P. when running at 520 revolutions per minute, although capable of giving higher outputs on an emergency. Speed is reduced by a large worm and worm-wheel, the worm-wheel being keyed to a shaft which carries two winding drums, and it is upon these drums that the steel ropes are wound which raise the lifts at their four corners.

One of the following figures shows the starting and reversing switches for bridges Nos. 3, 4 and 5. The starting switches are placed on the mezzanine level on the prompt side, from which the working of the bridges can be easily supervised. As usual with lifts, the bridges carry safety catches to guard against the event of a rope breaking, and automatic switches have been provided for cutting off the current from the motor in case of the attendant losing his head. These safety switches are fitted on the upright guides to each bridge, and are so placed as to cut off the current immediately the bridge arrives at the highest or lowest point. An arm which projects from the enclosed box containing the switch is knocked over as soon as the framework of the lift comes in contact with it. In addition, there is a magnetically-controlled brake on the motor shaft, which stops the motor as soon as the current is cut off. At the further end of the worm-shaft, *i.e.*, on the opposite end to where the motor is placed, and not visible in the illustration, there is a winding or windlass gear, which can be brought into action, so that the bridges can be worked by relays of men, in case of the electrical work having a breakdown.



Electric Scene-Store Lift Gear.

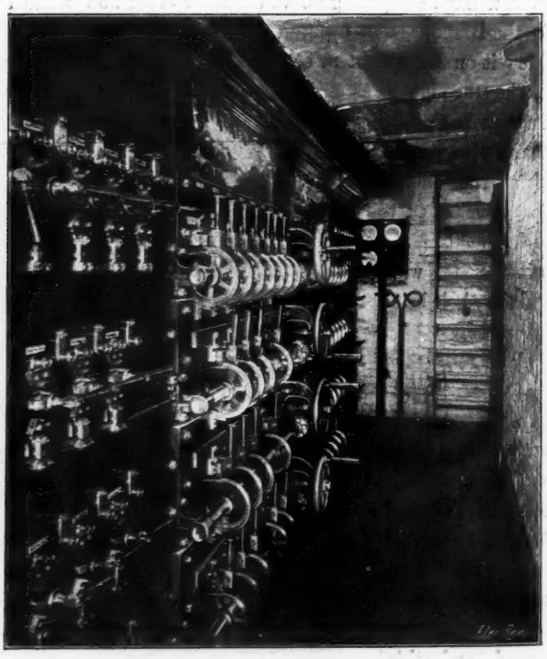


Controlling Gear for Bridges.

Regarding the hoist at the back of the stage referred to above, which has been described as the scenery-lifting gear, one of the figures shows the main features of this appliance, which has been placed in a niche some 30 ft. above stage-level on the prompt side. The object of the appliance is to raise 60-ft. lengths of scenery from the scene store below stage-level up to and on to the stage, the lengths of scenery being hung in bundles of three or four to wires running over pulleys and the wires being carried down onto the winding gear of the appliance illustrated.

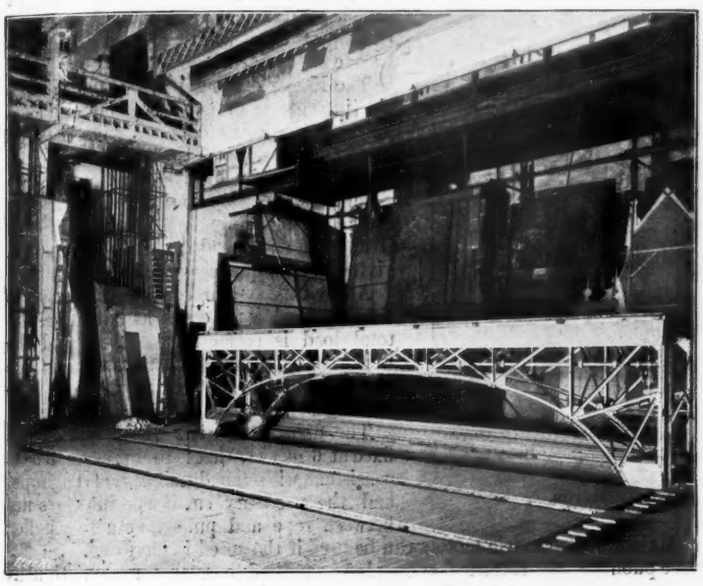
The maximum load of scenery to be hoisted at any one time is 15 cwt., and this load is to be raised at speeds varying from 60 to 100 ft. per minute. The motor is supplied from 100-volt mains, and is rated at 5 B.H.P.

The stage system of electric lighting is entirely independent of the system of lighting in the front of the house. The latter is of quite an ordinary character, the mains being run to different sections of the auditorium; the principal saloons, vestibules, &c., have a special switchboard placed in the cellar underneath the Bow Street vestibule. As far as the lighting of the stage is concerned, the system is the most elaborate to be found in these isles; in this case the work was done under the special direction of Mr. Wingfield Bowles, who had already been entrusted with the lighting scheme by the previous owners of the property, prior to the advent of the Grand Opera Syndicate. The current enters at cellar-level into a special chamber, where it goes from a main switchboard which carries two large change-over switches of 1,000 amperes each to the stage switch-room, which has been placed at mezzanine level along the front line of the stage, just below the curtain, in such a way that there is also a look-out hole over the stage from the floats close to the prompter's box. The figure below shows a view of the main switchboard in the switch-room; from here the lights are worked on two entirely distinct circuits, supplied from different sources, and in four colours, namely, orange, red, blue and white, with the greatest possible distributions. There is, of course, little that can be novel in the actual wiring of the stage, but the facts that there are four colours to be dealt with, and two distinct systems to supply, make the installation an interesting one. The six big battens are



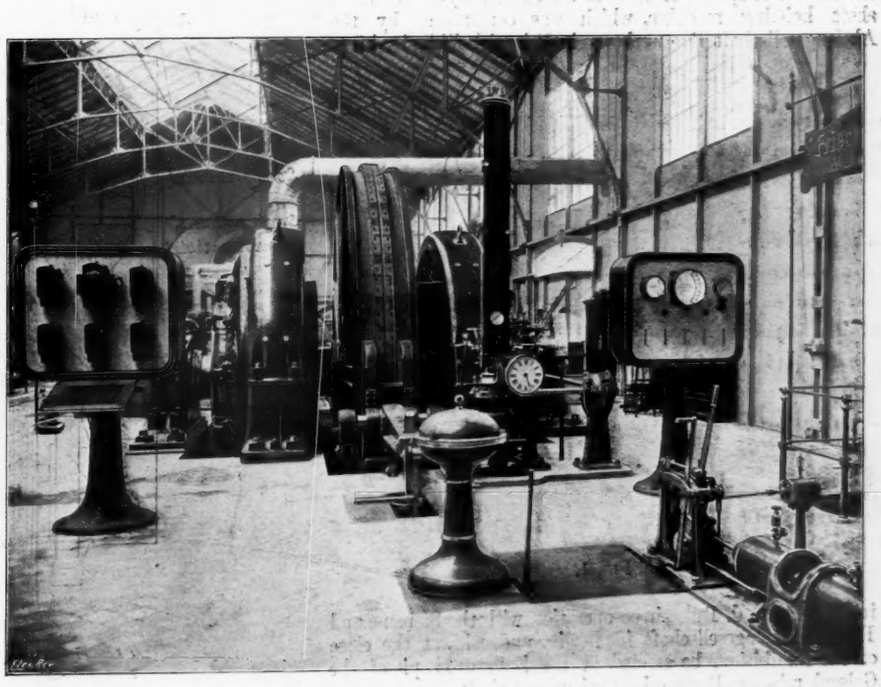
Main Switchboard.

60 ft. long, each holding 220 lamps of 16 c.p., divided into the following colours:—80 white, 40 orange, 50 red, and 50 blue lights. For these battens there are 24 regulators with liquid resistances, so that the intensity of light can be easily changed without causing any irregularity. Each colour on each batten can be varied independently. The six battens, 60 ft. long, are constructed in light steel lattice work, with a grooved oak plank to take the wiring. The cables at each end of the batten are carried down to the first fly gallery, where they are connected to special connecting-boxes, of special design. A few white lights are independently wired from a separate switch, so that when the stage lighting is not in use for scenic purposes, sufficient light can be obtained from the battens for ordinary carpentry and every-day work. The width of the battens is about 8 in. Each weighs approximately from 16 cwt. to 18 cwt., and is hung from steel ropes which are taken over the pulleys in the "gridiron" to a counter-weight arrangement similar to that of the scenery on the Brandt system. Of the six battens, three are worked from the one system of current and three from the other. What we have said regarding the battens applies practically to the "wing" ladders, the float and to the proscenium lights. The total number of lights in the float aggregates 250, of which the majority are again white lights, and each "wing" light carries 75 lamps, also split up in such a manner that there are quite as many white lights as there are of any other individual colour. It is unnecessary to remark that there has to be a considerable amount of plug work on a stage of this description, and a great deal of supplementary lighting, all of which has been carefully thought out, so as to light up a vast stage with due economy and regard to practical requirements. The resistances referred to above are placed in the main switch room on the cellar level, so that the wires, which run over pulleys in the switchboard, have an almost vertical drop into the resistances below. The switchboard has one particular feature in the form of four hand-wheels for the colours red, white, blue and orange respectively, of which any one will control its respective colour and as many of the circuits of that colour as may be required, each circuit being thrown into gear on to a shaft worked by these wheels worm-fashion. All the appliances are of course housed with due care against fire risk, the switch room being iron sheeted, and the main switch room built of brick with a concrete roof. Every possible care has been taken to ensure safety, and the stage wiring, as well as the whole of the installation, has been subjected to a number of tests by the various authorities who have control of the building.



One of the Bridges Raised.

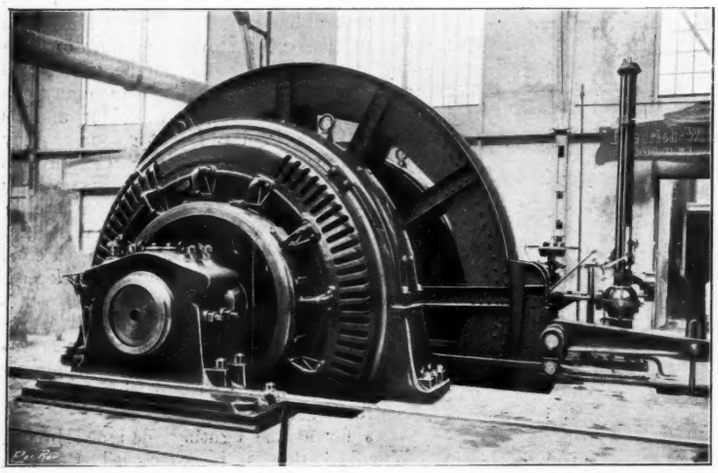
As far as the lighting, designed by Mr. Wingfield Bowles, is concerned, the firm engaged was Messrs. Townsend, Tamplin and Makovski. On the main stage mechanism, described in the earlier part of this article, the principal contractors were Messrs. Drew-Bear, Perks & Co., for all civil engineering work, and the Thames Iron Works and Engineering Company for all electrical mechanical work, Mr. Flood, of the electrical department, acting for the latter himself. In respect to the ventilation appliances, the Plenum system was adopted; the usual methods of fan work were applied by Messrs. Stott & Co., the motors selected being those of Messrs. Verity. The whole of the modernised appliances, which are now in full working order, were brought into use with considerable effect during the first week of the Coronation Opera Season, under the charge of Mr. Crawshaw, the electrician of the theatre; the stage manager, on whom so much depends, being Mr. Neilson, and the stage mechanist, Mr. Affleck.



Düsseldorf Exhibition: Electrically-Driven Hoisting Machine. (See next page.)

It is to be hoped, as has already been well shown during the early weeks of the Opera Season, that the efforts of Mr.

Sachs to give the metropolis all the improvements of a modernised stage, with the necessary appurtenances, will bear fruit, as in the case of the Covent Garden Theatre, and that the other great theatres of the metropolis, among which should rank primarily Drury Lane and Her Majesty's Theatre, will follow the example so ably set by the public-spirited directorate of the Grand Opera Syndicate.



Dusseldorf Exhibition: View of Hoisting Motor.

ELECTRICAL PLANT AT THE DUSSELDORF EXHIBITION.

(*Continued from page* 151.)

An exhibit of special interest is an electrically-driven main shaft hoisting machine, which was constructed by the Aktiengesellschaft Bergwerksverein Friedrich Wilhelmshütte in Mülheim a. d. Ruhr, in co-operation with the Siemens and Halske Aktiengesellschaft in Berlin, and will, at the close of the Exhibition, be erected at the Zollern II. pit of the Gelsenkirchener Bergwerks-Aktiengesellschaft.

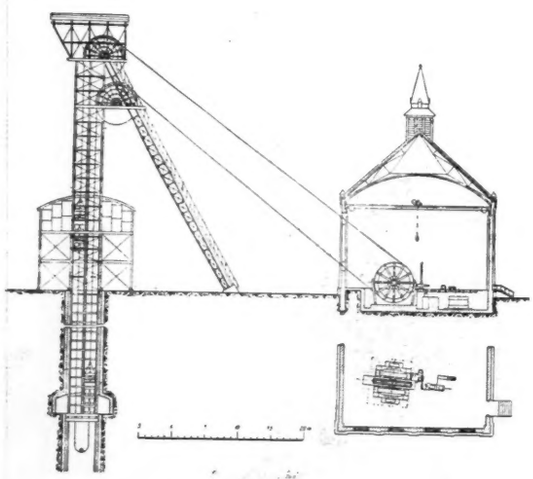


Fig. 1.

The latter firm operates all the machines of the new plant at the above-mentioned pit electrically, and decided in March, 1901, after a thorough study of the technical and economical questions involved in electric hoisting, to introduce electrically-operated main hoisting machines.

The machine is designed to raise a load of 4,200 kg. of coal, corresponding to six trucks of 700 kg. each, in one lift from a depth of 500 metres (at first 280 metres) with a maximum speed of 20 metres (at first 10 metres) per second. With 16 effective hoisting hours per day and a depth of 500 metres, the daily capacity is 2,700 tons, with a single unloading platform. With a double platform the capacity increases to 3,200 tons, and with three platforms to 4,000 tons.

The Koepe system of driving pulley is used, in which the hoisting rope passes but once around the pulley, and is driven by the friction of the oak lining, with which the groove is provided.

The Koepe driving pulley is most suitable in the case of hoisting from one level only, as the mechanical connection between the two cages, viz., the rope, renders a change in their relative position impossible. It has, moreover, the advantage of requiring only a very small constructional width and small moving masses, giving in consequence a quicker acceleration.

As by this system the hoisting rope is continued below the cages as tail rope, the total load is perfectly balanced, and the working conditions of the motors are very favourable, especially during the acceleration.

The diameter of the Koepe pulley was fixed at 6 metres, that is to say, as small as is consistent with the durability of the rope, and the necessary small specific pressure between rope and pulley, because smaller electric motors can be used if the speed is increased.

Electrical energy is transmitted to the motors as continuous current at 500 volts, because, in connection with a buffer storage battery, this gives a good storage of power for the very intermittent work, and, moreover, the gradual switching-in of the voltage, with increasing speed, allows of accelerating with a minimum loss.

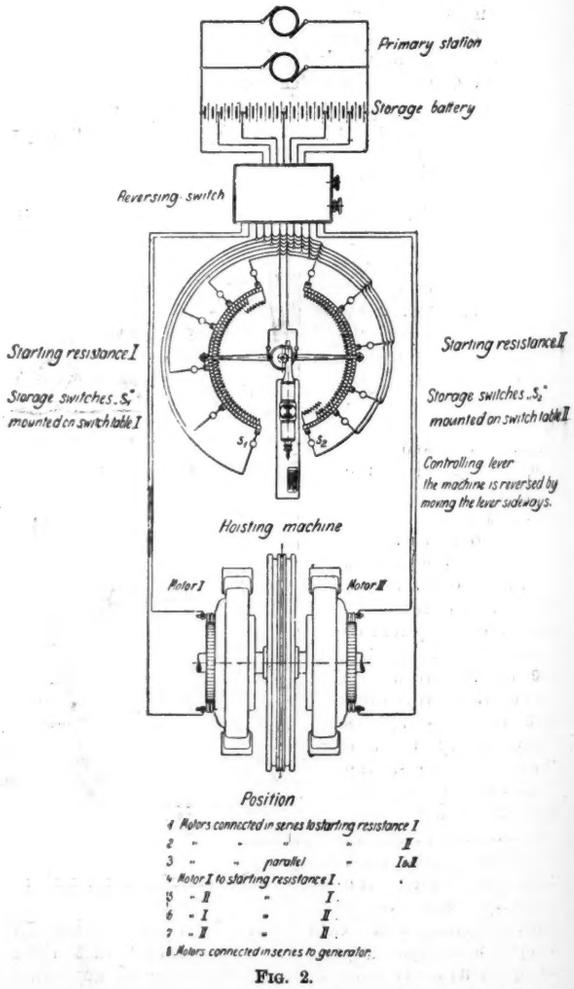

Primary station
Storage battery
Reversing switch
Starting resistance I
Storage switches S_1 mounted on switch table I
Starting resistance II
Storage switches S_2 mounted on switch table II
Controlling lever
the machine is reversed by moving the lever sideways.
Hoisting machine
Motor I
Motor II
Position
1 Motors connected in series to starting resistance I
2 " " " " II
3 " " parallel " I & II
4 Motor I to starting resistance I
5 " II " I
6 " I " II
7 " II " II
8 Motors connected in series to generator.

Fig. 2.

The general arrangement is, as figs. 1 and 3 show, very simple. On each side of the driving pulley, and keyed directly to the main axle, is an electric motor of 1,400 H.P. maximum. Outside the motors powerful main bearings are arranged, with automatic ring lubrication. Instead of a single driving motor, a set of two was chosen, partly because by series, or parallel control, the maximum hoisting speed could be either 10 or 20 metres per second, and partly because if one motor were stopped from one reason or another, the hoisting could be continued with reduced load, in order to bring the miners to bank, &c.

By the gradual switching in of the storage battery, and alteration of the exciting current of the motor magnets, other speeds can be attained without energy losses, so that the attainable speeds are 2, 4, 5, 6, 8—10, 12, 16—20 m. per sec. Since the losses at speeds intermediate to these

The gradual application of the voltage is attained by dividing the storage battery into four groups, and switching these groups in step by step, using small starting resistances between the groups.

The order in which the individual groups are switched in varies in alternate trips, first the one terminal of the whole battery being used as the fixed motor terminal, and then the other, or as we may say, the battery is discharged from right to left when the one cage is ascending, and from left to right when the other cage ascends. The various groups and cells will be thus subjected to as nearly as possible the same working conditions. A small number of cells at each end of the battery can be switched in individually. These are used for manœuvring, especially for the small movements necessary to unload the various stages of the cage at a single platform. These cells are charged by means of a special

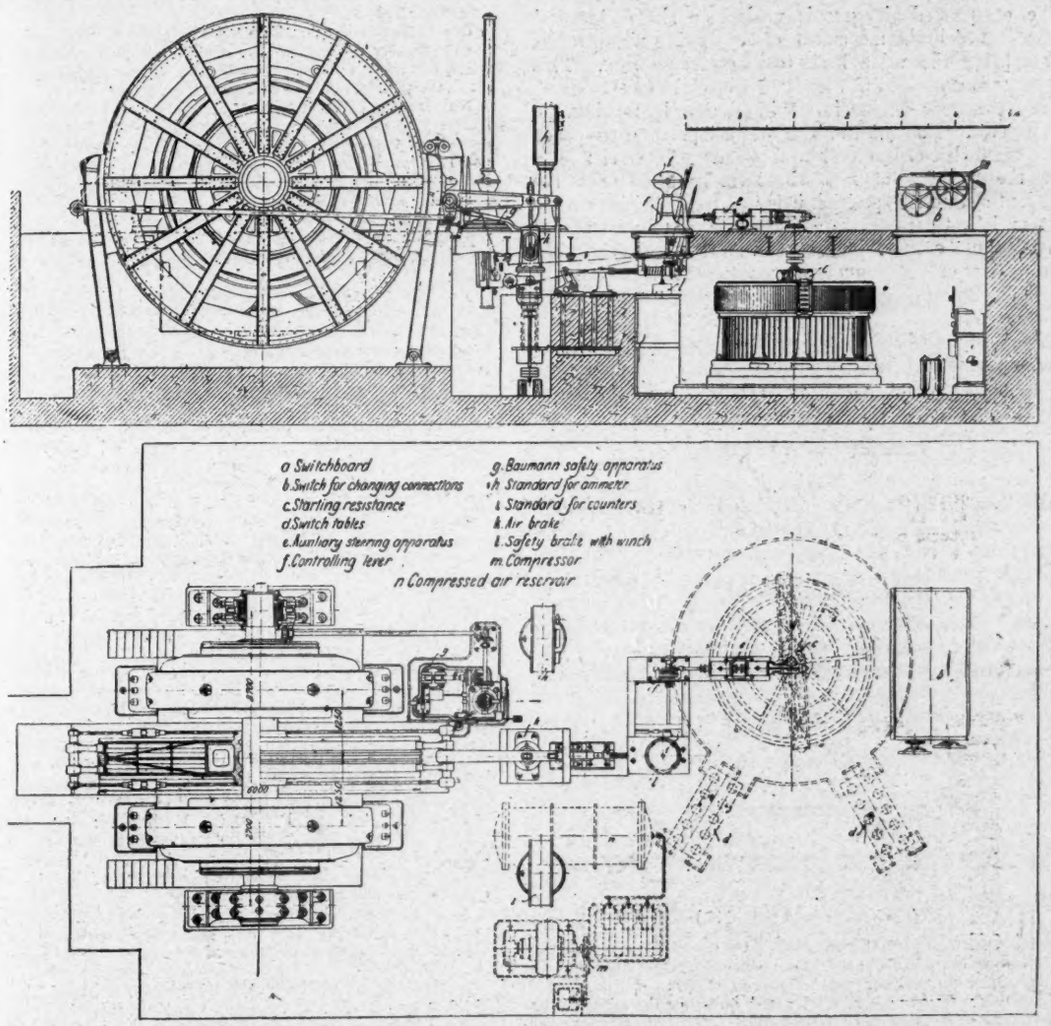


Fig. 3.

are very small, the machine can practically be run permanently at any speed. For rope examination the speed can be reduced to 30 cm. per second.

In front of the hoisting machine, as seen from the driver's position, is fixed the depth indicator, which shows the exact position of the cage in the shaft at any time, and is directly connected with a Baumann's safety device. The latter prevents the maximum speed being exceeded, and ensures a proper diminution of speed as the cage approaches the bank. If the speed exceeds the specified maximum at any point, the brake is automatically applied, the current being at the same time cut off. Moreover, below this safety device, and connected directly to it, is a so-called retarding apparatus, which automatically switches off the electric energy, by gradually turning back the lever of the starting gear, in case the attendant has neglected to do this, as the cage approaches the bank.

small boosting dynamo. The small but liberally designed starting resistances are combined with the above-mentioned starting switch gear under the motor driver's position. This starting gear of cylindrical form, carries on its outer periphery the switch contacts, in front of which the rotating switch arm moves.

The starting gear, the connection diagram of which is given in fig. 2, consists of two perfectly separated starting resistances.

At a speed of 20 m.p.s. each motor has its own starting resistance, but at 10 m.p.s., the two motors being in series, only one starting resistance is used. There is thus a perfect reserve. In addition to this the starting resistance is so arranged as to allow of various reserve connections being introduced by means of the grouping switch in the room above. These arrangements can be seen from fig. 2. It is thus possible, if one motor breaks down, to continue

work with the other, and, further, to connect either of the starting resistance with either of the motors. Provision is made so that the work can be continued with the battery cut out, in which case the two starting resistances are connected in series as a common starting resistance for the two motors, which are likewise in series.

The vertical axle of the starting gear is continued upwards through the arched foundation, and receives its movement through a rack and pinion from the pneumatic auxiliary regulating gear in the room above. The latter consists in the main of two cylinders bolted to a common centre block, the working cylinder and the dashpot cylinder, in which, connected simply by means of the piston rods, the pistons travel. These are also connected to the driving rod. The working piston is put into motion by means of compressed air, the dashpot piston serving to damp and arrest the motion.

The compressed air gear is worked on the differential system, in which the movement of the driving piston rod is used to bring the valve back to its centre position. This valve gear is contained in the steering block in front.

The pneumatic engine is set in motion by moving the switch lever. The path of the working piston corresponds exactly with that of the lever in the steering block slot.

In the position of rest, the lever leans towards the attendant; from this position it is first moved either to the right or left, thereby actuating through a compressed air transmission the switchgear in the rear, which determines the direction of rotation of the motors. Thus, when the lever is in the right-hand slot, the right-hand cage ascends, and *vice versâ*.

In addition to this switch lever, the steering block has a brake lever actuating the pneumatic brake. This brake lever has a stop which only allows of its motion when the switch lever is in the no-current position.

The pneumatic brake, distinguished by a brake cylinder fixed vertically in front of the hoisting machine, and actuating the four brake blocks by means of simple levers, differs very little from the usual steam brakes used with steam winding engines. As already mentioned, this can be actuated not only by the hand lever, but also by the safety apparatus, which at the same time cuts off the current. In addition to this, the main brake lever can be worked through a gravity screw brake which is fixed under the floor, the observer above seeing only a cast-iron pillar.

This pillar carries the weight-releasing lever, which can be worked by the attendant in case of the failure of the pneumatic brake. The pillar contains also a winch for winding up the fallen weight.

(To be continued.)

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 346.)

Post Office Telegraphs and Telephones.—We make the following extracts from the Postmaster-General's 48th report on the Post Office for the year ended March 31st, 1902.

Telegraphs:—The number of telegrams sent over the wires of the Department during the year was 90,432,041, the increase over the figures for 1900-01 being 95 per cent.

There has been a marked increase in the number of telegrams received and delivered by telephone at the Central Telegraph Office in London. The number of messages received during the year from telephone subscribers for transmission as telegrams amounted to 17,191, an increase over the preceding year of nearly 30 per cent., while 101,674 telegrams were received from the provinces for delivery by telephone, an increase of over 25 per cent. Including 13 at railway stations, 272 additional telegraph offices were opened, during the year.

There are now 11,784 telegraph offices in the United Kingdom—9,430 at post offices, and 2,354 at railway stations. As compared with the number for the year 1896-97—five years ago—this shows an increase of 1,601, or 15·7 per cent.

During the past winter the telegraph wires again suffered considerably from snow-storms. A particularly destructive storm occurred in December last, which practically cut off direct telegraphic communication between London and places north of Birmingham for four days. The cost of making good the damage to the lines maintained by the Post Office amounted to nearly £30,000. The effect of these interruptions has been to give greater prominence to the question of providing underground lines. The line between London and Birmingham proved of great value during the emergency; and I hope that next year it may be possible to place at my disposal larger funds in order to accelerate the execution of a comprehensive scheme. The London and Birmingham line has already been extended to Stafford, and it will be carried on during the present year to Warrington, where it will join existing underground lines between Manchester, Liverpool and Chester. The following large centres will then have underground communication with London:—Birmingham, Dudley, Wolverhampton, Stafford, Warrington, Manchester, Liverpool and Chester. Another exposed portion of the telegraph system which is to be protected by placing the wires underground is that between Preston and Penrith. About 34 miles of pipes have already been laid on this route. It is proposed to carry the underground line eventually as far as Lanark, whence branches will be laid to Glasgow and Edinburgh. The next extension will probably be from Manchester to the principal Yorkshire towns through Bradford and Leeds, and thence to Newcastle-on-Tyne.

Although the use of paper-insulated cable has considerably cheapened the cost of underground lines, they still involve a very heavy expenditure, and it will be necessary to proceed with caution. The London—Birmingham line cost £165,000, while the contemplated extension northwards will, it is estimated, involve a further expenditure of £700,000.

In addition to these underground extensions, much is being done to give greater stability to the service by the erection of reserve wires, carried as far as possible by alternative routes. These wires also have proved very useful during the past year.

Numerous additional telegraph circuits have been provided for the purpose of improving the communication between the large centres of trade, the most important being those between London and Liverpool (two wires), London and Plymouth, Birmingham and Portsmouth, London and Bradford, Liverpool and Dundee, and Liverpool and Swansea.

The wires in the new cable to Germany (referred to in the last report) were brought into use on May 29th, 1901, and in October last direct communication was established between Liverpool and Paris.

With the co-operation of the Belgian administration a cable has been laid between St. Margaret's Bay (Dover) and La Panne (Belgium) for the purpose of establishing direct telephonic communication between England and Belgium. The length of the cable is approximately 50 knots. It is more than twice the length of the cables between St. Margaret's Bay (Dover) and Calais, used in connection with the London—Paris telephone service, and is the longest cable of its kind in the world. The wires in the cable form two circuits, which will be placed at the disposal of the public as soon as the necessary arrangements have been completed.

Telephones.—On March 31st last the number of Post Office trunk wire centres was 328, an increase of 16 in the year. The trunk circuits in use numbered 1,165, and contained about 98,000 miles of wire. Out of the capital sum of £2,300,000 authorised by Parliament for the purchase and development of the trunk system, the expenditure up to March 31st last was approximately £1,896,649. The expenditure during the year was approximately £201,570.

The total number of trunk wire conversations during the year was 10,080,716, or, reckoning each conversation as involving at least two spoken messages, a total number of 20,161,432 messages (an increase of 12·31 per cent. over that of the preceding year). The gross trunk revenue was £238,720, as compared with £211,209, and the average value of each transaction was 5·68d., or practically the same as in the preceding year.

During the year the trunk system was extended to the following places, under guarantee from the National Telephone Company:—Alnwick, Andover, Driffield, Keswick, Marlborough, Newbury, Penrith, Whitby and Yeovil, and to the following places in connection with the new Post Office Exchanges:—Aylesbury, Abertillery, Billesdon, Caerphilly, Kinross, Skegness, Spalding and Stocksfield.

To serve places which were already on the system, 111 additional circuits were also authorised.

Local Exchanges.—Post office exchanges were opened during the year at the following places in the provinces, the exchange in each case being placed in connection with one of the exchanges on the trunk system:—

Aberkenfig, Abertillery, Annfield Plain, Bargoed, Bedlington, Blaenogwy, Blaina, Brynmawr, Caerau, Caerphilly, Chester-le-Street, Corbridge, Crickhowell, Crumlin, Dowlais, Griffiths Town, Hirst, Kinross, Llanbradach, Llantrisant, Maesteg, Mardy, Merthyr Vale, Newbridge (Mon.), Ogmore Vale, Pengam, Pontycymmer, Rhymney, Shortley Bridge, Skegness, Southerndown, Spalding, Stocksfield, Treharris, Tring, Troedyrhiw, Wendover, West Stanley, Wingate. Other exchanges are in course of construction.

London Telephone System.—The Central exchange of the London telephone system was opened on February 24th last, and about 500 subscribers had been connected on March 31st. Provision was made in the first instance for the accommodation of 5,400 subscribers, but the number of applications received has been so great that arrangements have had to be made for an early extension of the switchboard so as to accommodate over 10,000 lines, with a corresponding addition to the number of junction wires for connections with other exchanges. The service at this exchange has worked very smoothly, and many expressions of satisfaction have been received from the subscribers. The central battery system of supplying all the electricity required from the exchange has fully justified its adoption. It has rendered possible a simplification of the apparatus supplied to subscribers and the abolition of the batteries which were formerly required to be placed at their premises. These batteries required constant inspection, and their failure was a source of difficulty. The use of the lines by subscribers is much simplified, and the glow-lamp signals at the exchange, which mark every stage of a conversation, enable the

operators to give more rapid and efficient service to a greater number of subscribers. The speaking on the lines has been found to be very good, and their freedom from the accidents to which an overhead system is necessarily exposed justifies the hope of a more regular and satisfactory service than has hitherto been possible in London.

Exchanges have also been opened at Putney and Kingston-on-Thames, and other suburban exchanges are in process of construction at Wimbledon, Richmond, Chiswick, Twickenham and Croydon. More important exchanges are about to be opened in the neighbourhood of Victoria Street, Westminster, and in Cromwell Road, S.W. They will be known as the "Victoria" and "Western" exchanges, and will serve the intervening districts between the areas of the Central exchange and of the suburban exchanges mentioned above. Other important exchanges which are being constructed are one situated on the north side of Oxford Street and one in Finchley Road; they will be opened as soon as possible. These exchanges will serve large districts to the north of the areas served by the Victoria and Central exchange areas. Surveys for the construction of other exchanges and underground systems of wires have been made in outlying parts of the London area, and it is probable that exchanges will be established at Sutton and Epsom, which will serve the remaining districts to the west of the Croydon area and south of the Kingston and Wimbledon areas. The surveys of certain districts in the north-west of the London area are about to be undertaken.

The demand for telephonic service is increasing very rapidly, and the Metropolitan system will, in the course of the next few years, have to be developed to an extent which would have seemed impossible a few years ago. Dissatisfaction is necessarily caused by the slow rate at which the demand can be met, as it is hardly possible for individual subscribers to realise the amount of work involved in the general construction of the system. Already over 600 miles of underground pipes have been laid, and about 330 miles of cable, containing from 200 to 432 wires, have been drawn into them. The arrangements for the distribution of these wires into smaller cables for connection with the premises of subscribers, involve an enormous amount of minute work requiring great care and skill. The installation of subscribers' instruments can be undertaken only as this work is completed, and is a comparatively simple affair.

Out of the capital sum of £2,000,000 authorised by the Telegraph Act of 1899, an expenditure of £972,317 was sanctioned up to March 31st last. The authorised expenditure on the London system at that date was about £795,846.

On November 18th, 1901, an agreement was made with the National Telephone Company for inter-communication between the subscribers to the systems of the company and the Post Office in the London area. The agreement also provided for the abolition of terminal fees between telephone subscribers in London and the subscribers to the two systems in other places. This arrangement will undoubtedly be a great convenience to all telephone users in the London area, as it will prevent the unnecessary expense and inconvenience which would have been caused by the existence there of competitive and unconnected systems; and, by increasing largely the number of subscribers with whom conversation is possible over any exchange line, it much increases the value of the service given to each subscriber. It has involved a larger amount of additional work in connecting the exchanges of the two systems by numerous junction wires, and in the internal arrangements necessary for communication between exchanges worked on different principles. The work has, however, been carried out with much skill by the engineering staff of the Post Office, which has been greatly aided by the co-operation of the staff of the National Telephone Company. There is no previous instance of the combination of two systems of the same size or with so many differences in the mode of working; and it is very satisfactory that the communication between Post Office subscribers and those of the company is now as rapid and as efficient as between the subscribers to the same system.

During the year telephone licenses were granted to the Corporations of Brighton, Chard, and Portsmouth, and to the Norwich Mutual Telephone Company. Applications for licenses from several other Corporations and from one or two local companies have been received. The systems of the Corporations of Glasgow and Tunbridge Wells have been opened for use, but no other municipal exchanges have yet been established, although active steps in this direction are being taken by some of the Corporations concerned.

The revenue from the Post Office private wires and provincial telephone exchanges was £182,142, as against £155,694 in the previous year.

The amount of royalty received under licenses for exchange working was £151,626, made up as follows:—National Telephone Company, £149,907; other licensees, £1,719.

The amount paid by the National Telephone Company shows an increase of 6·73 per cent. over that paid by them in the preceding year.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 8th. Underground high pressure and low pressure cable system (three-phase, direct and telephone). See "Official Notices" July 4th.

Aston Manor.—September 19th. Coal bunkers and conveyor for the electricity works. See "Official Notices" to-day.

Bedford.—September 15th. Two boiler feed pumps. See "Official Notices" to-day.

Bexley.—September 4th. Permanent way, bonding, overhead equipment, car bodies, trucks and equipment. See "Official Notices" August 15th.

Bridgend. — The D.C. has resolved to advertise for tenders for electrical plant, &c.

Bristol. — September 10th. Electric wiring, bells, telephones; also boilers, economisers, piping, &c., for the Guardians' Infirmary. See "Official Notices" August 8th.

Christiania.—September 13th. "Telegrafog-Telefon-material," for the Norwegian State Railways. See this column for August 15th. Further particulars can be obtained on application to the office of the Inspector of Telegraphs, Stoners Gade, Christiania.

Dresden. — October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

France.—September 9th. The French Ministry of the Colonies is inviting tenders until September 9th for the supply of 100 tons of annealed galvanised iron wire, 5 mm. diameter, and two tons ditto, 2 mm. diameter, for the Post and Telegraph authorities in Cochin China, and 50 tons ditto, 5 mm. diameter, and one ton ditto, 2 mm. diameter, for Tonkin. Particulars may be obtained from, and tenders are to be sent to, Le Ministère des Colonies, Paris.

Italy.—September 27th. The Italian Department of Public Works will on this date consider offers for the concession of an electric tramway between Bayonne and Vigo.

Kirkcaldy.—September 8th. Electricity meters for the Corporation. See "Official Notices" August 22nd.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Leicester.—September 3rd. Tram rails, points, crossings, conduits, cables, overhead equipment, bonding, boilers, engines, generators, and other power station plant; also electric cars for the Corporation. See "Official Notices" July 18th.

Limerick. — September 1st. Hire-purchase wiring proposals are wanted by the Council. See "Official Notices" August 22nd.

Manchester.—August 30th. The Tramways Committee wants tenders for the supply of electrical repairing stores, electrical fitters' tools, oil and grease. Specifications, &c., from Mr. J. M. M'Elroy, General Manager, Tramways Department, 55, Piccadilly, Manchester.

Motor Cars. — Electrically-propelled brougham and omnibus. See "Official Notices" to-day.

N.E. Railway.—October 7th. The directors are inviting tenders for the complete electrification of about 37 miles of standard gauge line (double track mostly). For further particulars see our "Official Notices" July 25th.

Roumania.—September 3rd. The municipal administration of Ca'arasi-Stirbey (Roumania) is prepared to receive tenders for the concession of establishing and working the electric lighting service of the town.

Spain.—September 19th. Tenders are being invited until September 19th by the municipal authorities of Cabeza del Buey (Badajoz province), for the concession for the electric lighting of the town during a period of 25 years. Tenders are to be sent to El Secretario del Ayuntamiento de Cabeza del Buey (Badajoz), whence particulars may be obtained.

Spain.—September 20th. Tenders are being invited until September 20th, by the municipal authorities of Malagon (Ciudad Real province) for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Malagon (Ciudad Real), whence particulars may be obtained.

Spain.—September 29th. The Public Works Department, Madrid, wants offers for concession of an electric tramway between Vigo and Bayonne.

St. Petersburg.—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

Stretford.—August 30th. The U.D.C. invites tenders for the building of an electricity generating station, adjoining Lonford Bridge, Stretford.

Swansea.—September 1st. Telephone conduits, cables, wires, batteries, instruments, switchboards, &c., for municipal telephone equipment. See "Official Notices" August 15th.

Tien-Tsin. — November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

West Ham.—September 4th. Permanent way, bonding, &c., for 8 miles of tram route, for the Corporation. Plans, &c., from Mr. J. E. Waller, 29, Great George Street, S.W. (£5 deposit).

CLOSED.

France.—The French Post and Telegraph authorities in Paris have just given out contracts as follows:—La Compagnie des Trefileries du Havre, 150 tons of copper wire, 2½ mm. diameter at 166 fr. 85 c. per 100 kilog., and 50 tons ditto, 3 mm. diameter at 163 fr. 85 c.; La Compagnie Générale d'Electricité, Paris, 100 tons ditto, 3 mm. diameter at 164 fr. 40 c.; La Compagnie Française du Bi-Metal, Paris, 50 tons ditto, 3 mm. diameter at 163 fr. 90 c., and M. Grammont, of Pont-de-Cheruy, 50 tons ditto, 4 mm. diameter at 162 fr. 45 c.

Peterboro'.— The Corporation has decided to instal Willans engines of 250 H.P. direct coupled to multipolar traction generators made by Crompton & Co., Ltd., for supplying power to the tramways owned by the B.E.T. Co.

Reading.—Messrs. Warwick Bros. have recently installed in their old established timber works at Reading, a motor of 50-H.P. for driving circular saws, wood-planing and moulding machinery, &c., the power being derived from the 400-volt continuous current mains of the Reading Electrical Supply Company. The contract for the work was given to Messrs. A. Herbert & Co., of Reading, and the motor is of Messrs. T. Harding Churton & Co.'s multipolar standard "RM" type.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has placed the contracts for the construction of permanent way as follows:—Section A (Stalybridge and Mossley), Messrs. Underwood & Bros., Dukinfield. Section B (Dukinfield and Hyde), Messrs. Dick, Kerr & Co., Limited, 110, Cannon Street, London, E.C.

Victoria (Argentine).— Messrs. Willans & Robinson have received an order for two of their 100-H.P. standard compound engines, which will be coupled to machines made by the General Electric Company of New York. This plant is to be used for traction and lighting purposes.

Wrexham.—The T.C. has accepted the tender of the Lancashire Dynamo Company, for a 300-KW. steam dynamo (£3,974), and for a switchboard at £484 for electricity works extensions.

FORTHCOMING EVENTS.

Tuesday, September 16th.—Newcastle-on-Tyne. Celebration of the Jubilee of the Formation of the North of England Institute of Mining and Mechanical Engineers.

Wednesday, September 17th. Annual meeting of the Institution of Mining Engineers, Newcastle-on-Tyne.

NOTES.

Civil and Mechanical Engineers' Society.—Last Saturday a number of members of this Society visited the power station of the L.U.T. at Chiswick, thanks to the courtesy of Mr. J. Clifton Robinson. Several extensions have recently been carried out at this station, including two new Babcock boilers, a new 1,000-KW. B.T.H. three-phase alternator driven by an Allis vertical cross-compound engine, a new Wheeler condenser and pumps, and an addition to the cooling tower. The same Society recently visited the "bulk" works of the Met. E.S. Co. at Willesden, and admired the new Sulzer engine and Kolben 5,000-KW. alternator in course of erection.

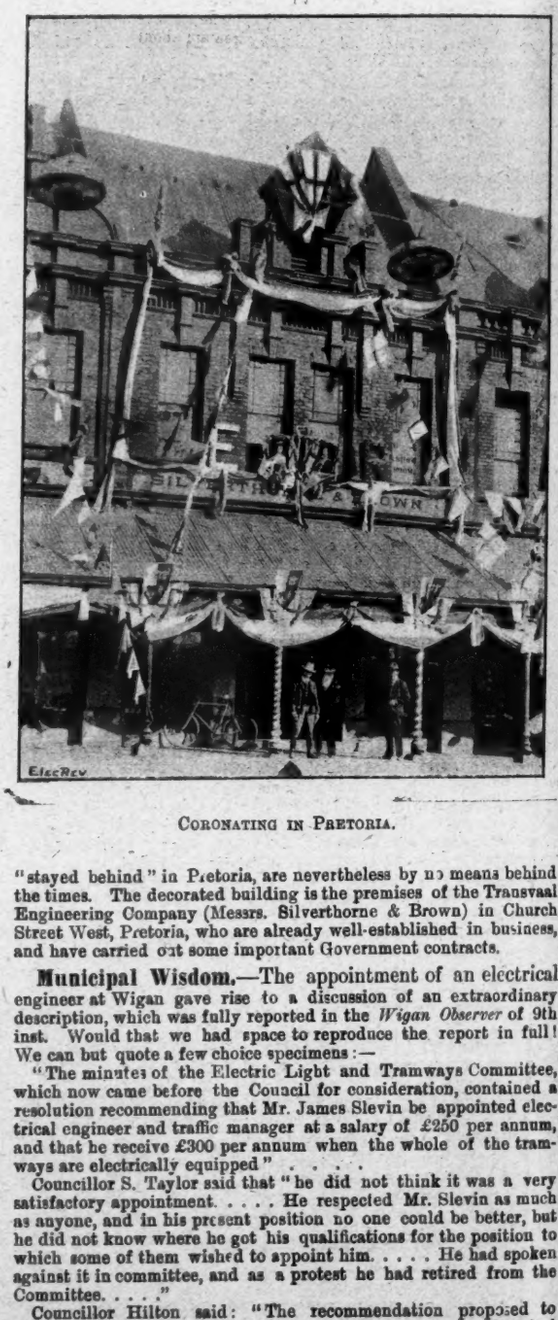
Personal. — Mr. Walter Riggs, of the Westminster Engineering Company, Limited, 16, Davies Street, Berkeley Square, W., and late of the P. & O. Steam Navigation Company, was married on August 21st at Brentford to Lilian, second daughter of W. A. Reading, Esq.

Mr. George Conaty, manager of the South Staffordshire Tramways, and president of the Birmingham Association of Mechanical Engineers, has been appointed manager of the City of Birmingham Tramways.

Mr. Tom Hawkins, managing director of the General Electric Company, was married at St. Peter's Church, Bedford, on August 19th, to Miss Dorothy Attenborough, third daughter of Mr. W. A. Attenborough, of Rawdon House, Bedford.

Mr. Wm. R. Bowker, formerly lecturer in electrical engineering at Preston, Nelson, and Southport Technical Schools, has been appointed lecturer in physics and electrical engineering at the Municipal Technical School, Halifax.

Coronation Decorations in Pretoria.—The accompanying illustration shows that some of the E.E.R.E.V.'s, who



CORONATING IN PRETORIA.

"stayed behind" in Pretoria, are nevertheless by no means behind the times. The decorated building is the premises of the Transvaal Engineering Company (Messrs. Silverthorne & Brown) in Church Street West, Pretoria, who are already well-established in business, and have carried out some important Government contracts.

Municipal Wisdom.—The appointment of an electrical engineer at Wigan gave rise to a discussion of an extraordinary description, which was fully reported in the *Wigan Observer* of 9th inst. Would that we had space to reproduce the report in full! We can but quote a few choice specimens:—

"The minutes of the Electric Light and Tramways Committee, which now came before the Council for consideration, contained a resolution recommending that Mr. James Slevin be appointed electrical engineer and traffic manager at a salary of £250 per annum, and that he receive £300 per annum when the whole of the tramways are electrically equipped" . . . . .

Councillor S. Taylor said that "he did not think it was a very satisfactory appointment. . . . . He respected Mr. Slevin as much as anyone, and in his present position no one could be better, but he did not know where he got his qualifications for the position to which some of them wished to appoint him. . . . . He had spoken against it in committee, and as a protest he had retired from the Committee. . . . ."

Councillor Hilton said: "The recommendation proposed to appoint to the responsible and important position of electrical engineer a man whose training did not fit him for it. . . . . It was most desirable if they wanted to secure the success they hoped for that they should appoint a thoroughly efficient, competent and qualified man, the very best they could get, and one who was an electrical engineer by profession, and not one who had picked up a smattering of electrical knowledge. Where was ability going to be

recognised and merit come in if men were going to be pitchforked into positions because they had friends in the Council? . . . ."

Alderman Phillips said that "in the crisis at which they had arrived, when they were about to enlarge their electrical undertaking by taking in the other tram lines, they should give even more salary, and advertise and get as good a man as they possibly could. . . . As Mr. Taylor had said, Mr. Slevin was an admirable man, and a personal friend of his own, and a man whom he would willingly assist in every way, but he loved his town a great deal better than he loved any individual. He could not support the proposal to give Mr. Slevin that important post.

Councillor Prescott said he thought there was no man so fit to take up the position as Mr. Slevin, who had been in the engineering line all his life. Mr. Slevin had worked all his life, he did not say at electrical engineering, because electrical engineering had not been in vogue so many years, *but he had had three or four years' experience, and it had not been in vogue much longer.* . . . They wanted to promote their own men, who were as amply qualified as the men they would advertise for and give £1,000 a year; men who would do nothing at all but say to one man "Do this," and to another, "Do that" (Hear, hear). It was all very fine for men to get such positions; about all that they did was to pick up the money every month, or every quarter, and do nothing themselves, but make other people do it. He felt that if they got Mr. Slevin in that position they would have the best man possible, *a man they could all talk to and tell him if things were not going right.* . . . .

Councillor Howard supported the appointment, and said he had taken *the opinion of a gentleman of his acquaintance who was very well qualified to express an opinion on the matter*, and his opinion was that what the Corporation required was not so much an electrical engineer as a mechanical engineer. (Hear, hear.) Taking into consideration that Mr. Slevin was acknowledged on all hands to be a fully qualified mechanical engineer, together with his four years' experience in the electrical department, he did not think they could do better than, at least, give Mr. Slevin a trial. . . . . He had known him a long time as an honest and conscientious worker, and, moreover, *electrical engineering was so strange to all of them, that he did not think any of them were qualified to express an opinion as to who was a qualified man.*

Councillor J. Wilson said that . . . . that was a special subject, and he had always been led to believe by those who were giving it a good deal of their attention, that anyone possessing only a little learning of electricity was in a very dangerous position, and that the better plan was to make a complete study and try to master it, or to leave the thing alone. The result had been that although that committee had been formed for three or four years, month after month up to the present, when the minutes had been submitted they had never been challenged, and for the reason he had ventured to state. . . .

Councillor Wood said he wished to support the amendment, though he regretted to do so for personal reasons. Mr. Slevin was a personal friend of his, and he should be very pleased to see him in the position if he thought him fully competent to take such a responsible post. . . .

Councillor Clarke, sen., supported the appointment, and said he thought that the fact of Mr. Slevin being a mechanical engineer, would be an advantage to the Council."

Councillor Gee next spoke, amid interruptions. He said that "the first reason why he supported the appointment of Mr. Selvin was because Mr. Slevin was a thoroughly qualified mechanical engineer, and he had it on the highest mechanical engineering authority in the town and district that during the last 3½ years Mr. Slevin had been making a study of *the inexact science of electricity*, about which the best scientific men in the world had only a hazy knowledge. He considered that Mr. Slevin, with his experience and qualifications, would make a competent electrical engineer for their works. . . . . Mr. Slevin would not be required to give them the benefit of that extraordinary electrical engineering experience which was spoken of, *because they would practically do away with the whole of the electrical engineering experience required*, and they would simply want a mechanical engineer, a man with his head screwed on the right way. . . . . ."

Councillor Fyans said that "they had engines of 2,000 H.P., and they had never used 5 H.P. yet, and yet they were asked to get another engine of 750 H.P. (A Councillor here demurred to Mr. Fyans' figures). He was not particular to hundreds or thousands that day. (Loud laughter.) Were the sub-stations ever used? Yes, at 12 o'clock at night. Mr. Fyans proceeded to say that *if there was any great science in electricity it was something that was unknown*, as no one could tell them how it was produced. . . . . A man had been appointed manager of the Sewage Farm direct from among the labourers, and they never had a better man. . . .

Councillor Richard Johnson (chairman of the Electric Light and Tramways Committee) said . . . . He asked them to vote for Mr. Slevin, because he believed he would be an excellent electrical engineer, and because he believed that at the present time he knew as much about electrical engineering as nineteen-twentieths of other people—cow-boys and others, who were posing as electrical engineers . . . . As to motive, he picked up the other day a book entitled "The American Invaders." The book had been well written and reviewed, and he should like to read about four lines from it in order to convince those friends of theirs who were talking about electrical engineering that it was quite possible for poor Wigan—this despised Nazareth of Lancashire, to do in 3½ years what had been done in America in one-third of the time . . . . The president of the Street Railways' Association . . . . was himself a mule-car driver in Kansas City. President Vreeland, head of the Metropolitan System of New York City, began life as a labourer in a gravel pit . . . . He would give the names of electrical engineers to-day who, a few years back, were mechanical engineers only. . . . . He read in the *Electric Journal* that . . . . . at a meeting of the Tramways and Electricity Committee at Leigh, it was resolved to offer the appointment of assistant electrical engineer to Mr. D. N. Kinghorn, engine driver at the works. That was proof itself that, in the opinion of the Leigh people, they were satisfied that the knowledge of electrical engineering was not a knowledge that belonged exclusively to a few people who had only had a little training, but it was as possible to be gained by men with a mechanical mind. He would now give the names of mechanical engineers who were electrical engineers and consulting engineers to-day. Mr. Robert Hammond, once a mechanical engineer, was now consulting engineer for Messrs. Fowler & Co., Leeds; Mr. A. E. Gibbons, late electrical engineer for Bradford; Mr. J. W. Chadwick, electrical engineer for Bradford; Mr. H. F. Parshall, consulting engineer for Dublin, Bradford, and Bristol.

Alderman Hilton: Will you give the ages of these people?

Councillor Richard Johnson: I did not inquire about the ages. If they had been horses, I might have looked at their teeth. (Laughter.) Continuing, Mr. Johnson said Mr. Harman Lewis, mechanical engineer, was electrical engineer for Leyton, Mr. Wordingham was a mechanical engineer who had a responsible position in Manchester, which he threw up, and he was now one of the most respected consulting engineers. At Leicester they had appointed their gas engineer as electrical engineer, and he was doing extremely well. (Laughter.) Mr. Johnson also mentioned the names of Mr. C. Robinson, mechanical engineer, who was electrical engineer to the London United, and Mr. Connor, chief engineer of the English Electrical Manufacturing Company, Preston, who, a short time back, was a mechanical engineer, and was made chief of that department, simply by virtue of his knowledge of mechanical engineering. Mr. John Hesketh, appointed tramways manager at Blackpool, was afterwards appointed electrical engineer and was now electrical and telegraph engineer to the New South Wales Government. . . . . Once the Council ridded itself of the feeling of racial hate, of bigotry and intolerance, then it would be possible to obtain the services of the best of their sons. It should not be said in their time that because Mr. Slevin was born in Wigan, and had only 3½ years' electrical knowledge on the top of 20 years' mechanical training, that he should be kept to the bottom for the purpose of giving preference to an unknown quantity. In Mr. Slevin they had a gentleman who could work the machinery in use with interest to the town, and thus help to relieve the rates, and enable the Committee to do something to show that the heads of the electric department were determined to do their best for the ratepayers, in spite of censure, and without fear or favour."

The amendment was lost, and afterwards the minutes were passed.

The remarks which we have italicised, together with the general drift of this sapient discussion, in quoting which the spelling, &c, of the local paper have been retained, will, we believe, be heartily appreciated by our readers. We now know somewhat of the reasoning upon which the appointment of electrical engineers is based, at any rate at Wigan. We have suspected similar arguments in connection with other places.

Electrical Development in the U.S.A.—In our comment last week upon the wholesale adoption of electricity in New York City, to meet every one of the new transportation problems, we remarked that this evidence of the importance of modern electrical development was encouragement to all engaged in the field, being but symptomatic of corresponding work and plans in other cities and in other parts of the world. As we have noted in another discussion of trolley work, the electrical engineer and manager finds himself by sheer growth and evolution of his work launched on enterprises and responsibilities, the magnitude of which he is prevented from realising by the mere activity itself that is thus forced upon him. It was but the other day that they were building cable lines in New York; it was but the other day that electrical tests on the elevated road were abandoned as unpromising; and yet all of a sudden the electrical engineer is aroused to the fact that all old and present work is swept away to make room for him and his methods. The distance that has thus been travelled in some ten years was admirably and strikingly brought out a few weeks ago by Mr. George H. Gibson before the American Association for the Advancement of Science. His paper, which was devoted to the economic influences of the electrical industries of Pittsburg, made a splendid generalisation of electrical development as a whole as a measure of civilisation. His impressive figures showed that the total electrical power in kilowatts per 1,000,000 people in the whole world, outside of the United States, is 640; in Great Britain, the highest outside of the United States, 7,000; while in the United States it is 26,320. The total capital invested in electrical undertakings in the world outside of the United States is 45 cents per capita; in Great Britain, the highest outside of the United States, it is $4.25, and in the United States $38.18. The miles of electrically operated railway are, in the whole world, outside of the United States, 4·64 per million people; in Germany, the next highest of foreign countries, 41·8 miles, and in the United States, 276·2 miles. Even more striking is the fact that the new plant of the Manhattan Elevated Railway, of New York City, will have a total power, available for traction, of 40,000 KW., equal to the total electric power available for traction purposes in France. Further, if we take New York City as a unit, the total power now available, or shortly to be available, will approximate that at present found in the Empire of Germany. The five mammoth power houses on Manhattan Island have a total normal rating of some 322,500 H.P., and a maximum rating of 478,000 H.P. This is enough power to lift the whole population at the rate of 80 ft. per minute, or much faster than an athletic man

Stretford.—August 30th. The U.D.C. invites tenders for the building of an electricity generating station, adjoining Lonford Bridge, Stretford.

Swansea.—September 1st. Telephone conduits, cables, wires, batteries, instruments, switchboards, &c, for municipal telephone equipment. See "Official Notices" August 15th.

Tien-Tsin. — November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

West Ham.—September 4th. Permanent way, bonding, &c, for 8 miles of tram route, for the Corporation. Plans, &c., from Mr. J. E. Waller, 29, Great George Street, S.W. (£5 deposit).

CLOSED.

France.—The French Post and Telegraph authorities in Paris have just given out contracts as follows:—La Compagnie des Trefileries du Havre, 150 tons of copper wire, 2½ mm. diameter at 166 fr. 85 c. per 100 kilog., and 50 tons ditto, 3 mm. diameter at 163 fr. 85 c.; La Compagnie Générale d'Electricité, Paris, 100 tons ditto, 3 mm. diameter at 164 fr. 40 c.; La Compagnie Française du Bi-Metal, Paris, 50 tons ditto, 3 mm. diameter at 163 fr. 90 c., and M. Grammont, of Pont-de-Cheruy, 50 tons ditto, 4 mm. diameter at 163 fr. 45 c.

Peterboro'.— The Corporation has decided to instal Willans engines of 250 H.P. direct coupled to multipolar traction generators made by Crompton & Co., Ltd., for supplying power to the tramways owned by the B.E.T. Co.

Reading.—Messrs. Warwick Bros. have recently installed in their old established timber works at Reading, a motor of 50-H.P. for driving circular saws, wood-planing and moulding machinery, &c., the power being derived from the 400-volt continuous current mains of the Reading Electrical Supply Company. The contract for the work was given to Messrs. A. Herbert & Co., of Reading, and the motor is of Messrs. T. Harding Churton & Co.'s multipolar standard "RM" type.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has placed the contracts for the construction of permanent way as follows:—Section A (Stalybridge and Mossley), Messrs. Underwood & Bros., Dukinfield. Section B (Dukinfield and Hyde), Messrs. Dick, Kerr & Co., Limited, 110, Cannon Street, London, E.C.

Victoria (Argentine).— Messrs. Willans & Robinson have received an order for two of their 100-H.P. standard compound engines, which will be coupled to machines made by the General Electric Company of New York. This plant is to be used for traction and lighting purposes.

Wrexham.—The T.C. has accepted the tender of the Lancashire Dynamo Company, for a 300-KW. steam dynamo (£3,974), and for a switchboard at £484 for electricity works extensions.

FORTHCOMING EVENTS.

Tuesday, September 16th.—Newcastle-on-Tyne. Celebration of the Jubilee of the Formation of the North of England Institute of Mining and Mechanical Engineers.

Wednesday, September 17th. Annual meeting of the Institution of Mining Engineers, Newcastle-on-Tyne.

NOTES.

Civil and Mechanical Engineers' Society.—Last Saturday a number of members of this Society visited the power station of the L.U.T. at Chiswick, thanks to the courtesy of Mr. J. Clifton Robinson. Several extensions have recently been carried out at this station, including two new Babcock boilers, a new 1,000-KW. B.T.H. three-phase alternator driven by an Allis vertical cross-compound engine, a new Wheeler condenser and pumps, and an addition to the cooling tower. The same Society recently visited the "bulk" works of the Met. E.S. Co. at Willesden, and admired the new Sulzer engine and Kolben 5,000-KW. alternator in course of erection.

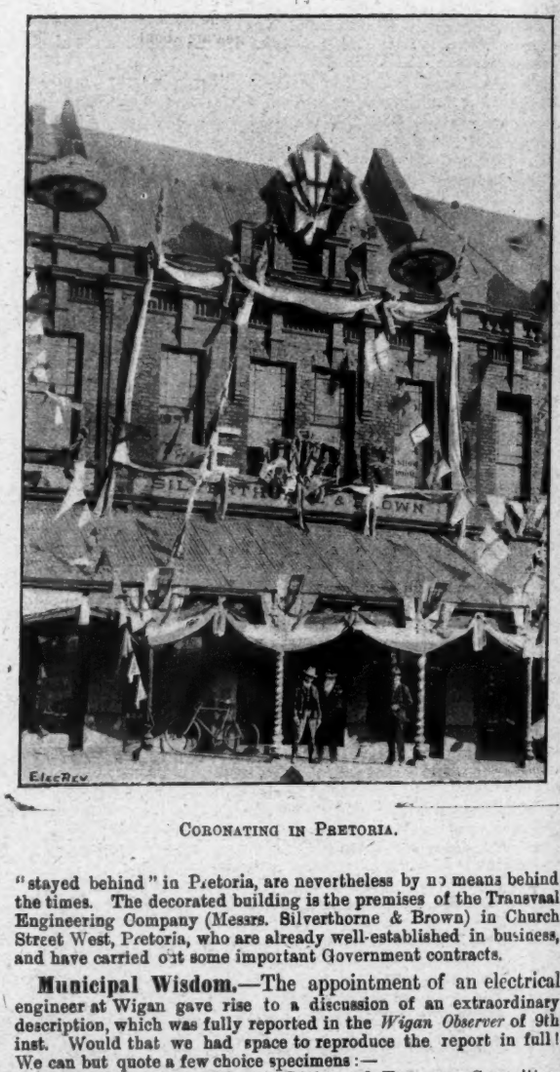
Personal. — Mr. Walter Riggs, of the Westminster Engineering Company, Limited, 16, Davies Street, Berkeley Square, W., and late of the P. & O. Steam Navigation Company, was married on August 21st at Brentford to Lilian, second daughter of W. A. Reading, Esq.

Mr. George Conaty, manager of the South Staffordshire Tramways, and president of the Birmingham Association of Mechanical Engineers, has been appointed manager of the City of Birmingham Tramways.

Mr. Tom Hawkins, managing director of the General Electric Company, was married at St. Peter's Church, Bedford, on August 19th, to Miss Dorothy Attenborough, third daughter of Mr. W. A. Attenborough, of Rawdon House, Bedford.

Mr. Wm. R. Bowker, formerly lecturer in electrical engineering at Preston, Nelson, and Southport Technical Schools, has been appointed lecturer in physics and electrical engineering at the Municipal Technical School, Halifax.

Coronation Decorations in Pretoria.—The accompanying illustration shows that some of the E.E.R.E.V.'s, who



CORONATING IN PRETORIA.

"stayed behind" in Pretoria, are nevertheless by no means behind the times. The decorated building is the premises of the Transvaal Engineering Company (Messrs. Silverthorne & Brown) in Church Street West, Pretoria, who are already well-established in business, and have carried out some important Government contracts.

Municipal Wisdom.—The appointment of an electrical engineer at Wigan gave rise to a discussion of an extraordinary description, which was fully reported in the *Wigan Observer* of 9th inst. Would that we had space to reproduce the report in full! We can but quote a few choice specimens:—

"The minutes of the Electric Light and Tramways Committee, which now came before the Council for consideration, contained a resolution recommending that Mr. James Slevin be appointed electrical engineer and traffic manager at a salary of £250 per annum, and that he receive £300 per annum when the whole of the tramways are electrically equipped" . . . .

Councillor S. Taylor said that "he did not think it was a very satisfactory appointment. . . . . He respected Mr. Slevin as much as anyone, and in his present position no one could be better, but he did not know where he got his qualifications for the position to which some of them wished to appoint him. . . . . He had spoken against it in committee, and as a protest he had retired from the Committee. . . . ."

Councillor Hilton said: "The recommendation proposed to appoint to the responsible and important position of electrical engineer a man whose training did not fit him for it. . . . . It was most desirable if they wanted to secure the success they hoped for that they should appoint a thoroughly efficient, competent and qualified man, the very best they could get, and one who was an electrical engineer by profession, and not one who had picked up a smattering of electrical knowledge. Where was ability going to be

recognised and merit come in if men were going to be pitchforked into positions because they had friends in the Council? . . . ."

Alderman Phillips said that "in the crisis at which they had arrived, when they were about to enlarge their electrical undertaking by taking in the other tram lines, they should give even more salary, and advertise and get as good a man as they possibly could. . . . As Mr. Taylor had said, Mr. Slevin was an admirable man, and a personal friend of his own, and a man whom he would willingly assist in every way, but he loved his town a great deal better than he loved any individual. He could not support the proposal to give Mr. Slevin that important post.

Councillor Prescott said he thought there was no man so fit to take up the position as Mr. Slevin, who had been in the engineering line all his life. Mr. Slevin had worked all his life, he did not say at electrical engineering, because electrical engineering had not been in vogue so many years, *but he had had three or four years' experience, and it had not been in vogue much longer.* . . . They wanted to promote their own men, who were as amply qualified as the men they would advertise for and give £1,000 a year; men who would do nothing at all but say to one man "Do this," and to another, "Do that" (Hear, hear). It was all very fine for men to get such positions; about all that they did was to pick up the money every month, or every quarter, and do nothing themselves, but make other people do it. He felt that if they got Mr. Slevin in that position they would have the best man possible, *a man they could all talk to and tell him if things were not going right.* . . . .

Councillor Howard supported the appointment, and said he had taken *the opinion of a gentleman of his acquaintance who was very well qualified to express an opinion on the matter*, and his opinion was that what the Corporation required was not so much an electrical engineer as a mechanical engineer. (Hear, hear.) Taking into consideration that Mr. Slevin was acknowledged on all hands to be a fully qualified mechanical engineer, together with his four years' experience in the electrical department, he did not think they could do better than, at least, give Mr. Slevin a trial. . . . . He had known him a long time as an honest and conscientious worker, and, moreover, *electrical engineering was so strange to all of them, that he did not think any of them were qualified to express an opinion as to who was a qualified man.*

Councillor J. Wilson said that . . . . that was a special subject, and he had always been led to believe by those who were giving it a good deal of their attention, that anyone possessing only a little learning of electricity was in a very dangerous position, and that the better plan was to make a complete study and try to master it, or to leave the thing alone. The result had been that although that committee had been formed for three or four years, month after month up to the present, when the minutes had been submitted they had never been challenged, and for the reason he had ventured to state. . . .

Councillor Wood said he wished to support the amendment, though he regretted to do so for personal reasons. Mr. Slevin was a personal friend of his, and he should be very pleased to see him in the position if he thought him fully competent to take such a responsible post. . . .

Councillor Clarke, sen., supported the appointment, and said he thought that the fact of Mr. Slevin being a mechanical engineer, would be an advantage to the Council."

Councillor Gee next spoke, amid interruptions. He said that "the first reason why he supported the appointment of Mr. Selvin was because Mr. Slevin was a thoroughly qualified mechanical engineer, and he had it on the highest mechanical engineering authority in the town and district that during the last 3½ years Mr. Slevin had been making a study of *the inexact science of electricity*, about which the best scientific men in the world had only a hazy knowledge. He considered that Mr. Slevin, with his experience and qualifications, would make a competent electrical engineer for their works. . . . . Mr. Slevin would not be required to give them the benefit of that extraordinary electrical engineering experience which was spoken of, *because they would practically do away with the whole of the electrical engineering experience required*, and they would simply want a mechanical engineer, a man with his head screwed on the right way. . . . . "

Councillor Fyans said that "they had engines of 2,000 H.P., and they had never used 5 H.P. yet, and yet they were asked to get another engine of 750 H.P. (A Councillor here demurred to Mr. Fyans' figures). He was not particular to hundreds or thousands that day. (Loud laughter.) Were the sub-stations ever used? Yes, at 12 o'clock at night. Mr. Fyans proceeded to say that *if there was any great science in electricity it was something that was unknown*, as no one could tell them how it was produced. . . . . A man had been appointed manager of the Sewage Farm direct from among the labourers, and they never had a better man. . . .

Councillor Richard Johnson (chairman of the Electric Light and Tramways Committee) said . . . . He asked them to vote for Mr. Slevin, because he believed he would be an excellent electrical engineer, and because he believed that at the present time he knew as much about electrical engineering as nineteen-twentieths of other people—cow-boys and others, who were posing as electrical engineers . . . . As to motive, he picked up the other day a book entitled "The American Invaders." The book had been well written and reviewed, and he should like to read about four lines from it in order to convince those friends of theirs who were talking about electrical engineering that it was quite possible for poor Wigan—this despised Nazareth of Lancashire, to do in 3½ years what had been done in America in one-third of the time . . . . The president of the Street Railways' Association . . . . was himself a mule-car driver in Kansas City. President Vreeland, head of the Metropolitan System of New York City, began life as a labourer in a gravel pit . . . . He would give the names of electrical engineers to-day who, a few years back, were mechanical engineers only. . . . . He read in the *Electric Journal* that . . . . . at a meeting of the Tramways and Electricity Committee at Leigh, it was resolved to offer the appointment of assistant electrical engineer to Mr. D. N. Kinghorn, engine driver at the works. That was proof itself that, in the opinion of the Leigh people, they were satisfied that the knowledge of electrical engineering was not a knowledge that belonged exclusively to a few people who had only had a little training, but it was possible to be gained by men with a mechanical mind. He would now give the names of mechanical engineers who were electrical engineers and consulting engineers to-day. Mr. Robert Hammond, once a mechanical engineer, was now consulting engineer for Messrs. Fowler & Co., Leeds; Mr. A. E. Gibbons, late electrical engineer for Bradford; Mr. J. W. Chadwick, electrical engineer for Bradford; Mr. H. F. Parshall, consulting engineer for Dublin, Bradford, and Bristol.

Alderman Hilton: Will you give the ages of these people?

Councillor Richard Johnson: I did not inquire about the ages. If they had been horses, I might have looked at their teeth. (Laughter.) Continuing, Mr. Johnson said Mr. Harman Lewis, mechanical engineer, was electrical engineer for Leyton, Mr. Wordingham was a mechanical engineer who had a responsible position in Manchester, which he threw up, and he was now one of the most respected consulting engineers. At Leicester they had appointed their gas engineer as electrical engineer, and he was doing extremely well. (Laughter.) Mr. Johnson also mentioned the names of Mr. C. Robinson, mechanical engineer, who was electrical engineer to the London United, and Mr. Connor, chief engineer of the English Electrical Manufacturing Company, Preston, who, a short time back, was a mechanical engineer, and was made chief of that department, simply by virtue of his knowledge of mechanical engineering. Mr. John Hesketh, appointed tramways manager at Blackpool, was afterwards appointed electrical engineer and was now electrical and telegraph engineer to the New South Wales Government. . . . . Once the Council ridded itself of the feeling of racial hate, of bigotry and intolerance, then it would be possible to obtain the services of the best of their sons. It should not be said in their time that because Mr. Slevin was born in Wigan, and had only 3½ years' electrical knowledge on the top of 20 years' mechanical training, that he should be kept to the bottom for the purpose of giving preference to an unknown quantity. In Mr. Slevin they had a gentleman who could work the machinery in use with interest to the town, and thus help to relieve the rates, and enable the Committee to do something to show that the heads of the electric department were determined to do their best for the ratepayers, in spite of censure, and without fear or favour."

The amendment was lost, and afterwards the minutes were passed.

The remarks which we have italicised, together with the general drift of this sapient discussion, in quoting which the spelling, &c, of the local paper have been retained, will, we believe, be heartily appreciated by our readers. We now know somewhat of the reasoning upon which the appointment of electrical engineers is based, at any rate at Wigan. We have suspected similar arguments in connection with other places.

Electrical Development in the U.S.A.—In our comment last week upon the wholesale adoption of electricity in New York City, to meet every one of the new transportation problems, we remarked that this evidence of the importance of modern electrical development was encouragement to all engaged in the field, being but symptomatic of corresponding work and plans in other cities and in other parts of the world. As we have noted in another discussion of trolley work, the electrical engineer and manager finds himself by sheer growth and evolution of his work launched on enterprises and responsibilities, the magnitude of which he is prevented from realising by the mere activity itself that is thus forced upon him. It was but the other day that they were building cable lines in New York; it was but the other day that electrical tests on the elevated road were abandoned as unpromising; and yet all of a sudden the electrical engineer is aroused to the fact that all old and present work is swept away to make room for him and his methods. The distance that has thus been travelled in some ten years was admirably and strikingly brought out a few weeks ago by Mr. George H. Gibson before the American Association for the Advancement of Science. His paper, which was devoted to the economic influences of the electrical industries of Pittsburg, made a splendid generalisation of electrical development as a whole as a measure of civilisation. His impressive figures showed that the total electrical power in kilowatts per 1,000,000 people in the whole world, outside of the United States, is 640; in Great Britain, the highest outside of the United States, 7,000; while in the United States it is 26,320. The total capital invested in electrical undertakings in the world outside of the United States is 45 cents per capita; in Great Britain, the highest outside of the United States, it is $4.25, and in the United States $38.18. The miles of electrically operated railway are, in the whole world, outside of the United States, 4·64 per million people; in Germany, the next highest of foreign countries, 41·8 miles, and in the United States, 276·2 miles. Even more striking is the fact that the new plant of the Manhattan Elevated Railway, of New York City, will have a total power, available for traction, of 40,000 KW., equal to the total electric power available for traction purposes in France. Further, if we take New York City as a unit, the total power now available, or shortly to be available, will approximate that at present found in the Empire of Germany. The five mammoth power houses on Manhattan Island have a total normal rating of some 322,500 H.P., and a maximum rating of 478,000 H.P. This is enough power to lift the whole population at the rate of 80 ft. per minute, or much faster than an athletic man

can for any length of time run upstairs. In other words, the work of these five central power plants is more than could be done by all the people on the Island working continuously. In the United States is developed 69 per cent. of all electricity available in the world, 76 per cent. of all that portion available for traction, 76½ per cent. of all the electric railway mileage, and 83½ per cent. of all the trolley cars. These are, indeed, profoundly impressive and suggestive figures, so far as the lighting and power of the United States are concerned, and might even be carried further. If we take into account the consumption annually of electrical apparatus in the United States, and add to it the amounts spent on trolley riding, electric lighting, telegraphy and telephone service, it is soon seen that we are spending more as a nation for electricity than for daily bread. The sum spent on electricity certainly reaches between $7 and $8 per head, in the United States; a figure far surpassing the corresponding expenditure of any other nation.—*Electrical World* of New York.

Formation Temperature of Calcium Carbide.—Borchers has recently described some experiments dealing with an attempt to determine the conditions underlying the formation of calcium carbide, and the minimum temperature at which that body can be produced. A graphite crucible fitted with two depending tubes made of magnesite was charged with wood charcoal and lime in alternate layers, using an excess of the former, since part of it was required as fuel. One of the magnesite tubes was connected with a metal pipe coiled round the outside of the vessel—an arrangement which enabled the gas blown into the crucible to be heated beforehand. The mixture of carbon and lime was then heated by passing into the crucible, in different experiments, ordinary air, air containing 35 per cent. of oxygen, 50 per cent. oxygen, and pure oxygen, setting fire to the charcoal, and making it burn in the current of gas. It was found that 35 per cent. oxygen yielded no trace of carbide, but that with a blast 50 or 60 per cent. strong in oxygen, a moderate amount of calcium carbide was recovered in a crystalline condition. Taking the heat of formation of carbon monoxide as 26·5 calories, using Mallard and Le Chatelier's formula for the variations in the specific heat of that gas and of nitrogen

$$[6{\cdot}5 + 0{\cdot}001\,(t + 273)],$$

and assuming there to be no loss of heat by radiation, &c., from the furnace, it may be calculated that the temperature of the crucible should be as follows:—

With pure oxygen	3,100° C.
„ 50 per cent. oxygen ...	2,200° C.
„ 35 per cent. oxygen ...	1,800° C.
„ air only	1,260° C.

Probably, however, the temperature in the furnace may be greater than these figures represent if any carbon dioxide is produced. The experiments seem to show that calcium carbide is only produced in notable quantities at a temperature exceeding 2,000° C. Coal gas cannot be used as fuel for work at such temperatures as these, because it contains too much hydrogen, which no longer burns under the conditions obtaining. This has been exemplified by Mögenburg, who passed coal gas through an electrically heated chamber together with such a volume of high-grade oxygen that the gas issuing from the top of the vessel no longer burnt with a luminous flame. The carbon was oxidised mainly to monoxide, a little dioxide being observed; but the hydrogen escaped quantitatively as such.

It is interesting to compare Borchers' figure, 2,000° C., with the temperature, 1,620° C., given by Rothmund as the lowest point at which calcium carbide is produced (ELECTRICAL REVIEW, August 15th, 1902, p. 273); but it should be remembered that Rothmund was experimenting with an electric furnace—that is to say, he was conducting his research on lines that resemble those of practice, whereas Borchers was employing a metallurgical process, by the aid of which calcium carbide has never yet been manufactured on a scale of reasonable magnitude; added to which he was using an excess of carbon instead of the excess of lime taken in all electric furnace charges.

Preparation of Barium Carbide from Psilomelane.—C. Limb, of Lyons, has taken out a German patent for the manufacture of barium carbide and metallic manganese from psilomelane. This is a common ore of manganese found in Devonshire, Cornwall, and various parts of the Continent, which is an oxide intermediate in composition between the sesquioxide and the dioxide. Its generic formula is $RO\,MnO_2\,H_2O$, where RO devotes manganese monoxide more or less replaced by the oxides of barium and potassium, the latter two ingredients sometimes reaching 40 per cent. of the entire material. Psilomelane is an opaque grey or black mineral, having a specific gravity ranging from 3·7 to 4·33, and a hardness to 5 to 6. It frequently occurs in alternate layers with pyrolusite. According to Limb, this ore has not hitherto been found of much service; but he has discovered that it can be worked up in the electric furnace. The substance is first roasted in order to destroy its peroxide with the view of subsequently economising the quantity of carbon required; it is then mixed with carbon in amount equivalent to the barium present, taking altogether 23·5 parts of carbon for every 100 parts of barium oxide, and 75 parts of carbon for 100 parts of oxygen. The whole is next ignited at a high temperature. The product consists of barium carbide, which can be used in the ordinary manner for generating acetylene by treatment with water; and manganese, which is a saleable material. The latter metal may also be purified by ignition with chalk or some oxidising substance such as manganese oxide, and then employed for a variety of metallurgical purposes.

The B.A. Meeting.—From the *Times* customary forecast of the British Association meeting, we glean the following particulars of matters within our province likely to come on at Belfast next month:—Dr. Garson is now the assistant general secretary, in succession to the late Mr. George Griffith. The president, Prof. James Dewar, F.R.S., will deliver his address on the evening of Wednesday, September 10th; he will keep "to his own special subject of chemistry, and will probably trace the progress in physical chemistry through the school of Boyle, Black, Andrews, and Thomson, pointing out what it has led up to in our own day." Prof. John Purser is to preside over Section A, where it is expected that Lord Rayleigh "will probably raise the question of the conservation of weight in chemical reaction; Prof. Trouton may be able to show his experiments on the magnetic field, due to the motion of a charged condenser; Prof. Martin will communicate some results in electrical oscillation, and some experimental work done by students under his direction; while Dr. Larmor will have something to say on the temperature of radiant energy. Mr. Petavel has promised a paper on radiation experiments, with a view to the construction of a more trustworthy standard of light."

In the Economic Science and Statistics Section, as might be expected, the question of municipal enterprise will be considered, also factory legislation, preferential tariffs, and technical instruction and industrial development. In the Engineering Section (G), the president thereof (Prof. John Perry) will deliver an address on the training of engineers. Prof. Hele-Shaw is expected to present an important report, embodying the result of the deliberations of the Road Traction Committee, while the report of the Screw Gauge Committee is likely to conclude a prolonged discussion of an important point of detail in small mechanisms. Among the papers that have been promised are the following:—"The Combustion of Bituminous Coal," by Mr. W. H. Booth; "Water-Power in Ireland," by Mr. F. J. Dick; "Exhibition of Electrical Apparatus," by Mr. M. B. Field; "Recent Progress in Large Gas Engines," by Mr. H. A. Humphrey; "The Importance of Minor Details in Engineering Work," by Mr. L. Holroyd Smith; and "Direct Reducing Levelling Staff," by Mr. G. W. Herdman. Papers on some electrical subject have been promised by Mr. P. V. McMahon and Mr. F. Holden, and Mr. J. E. Kingsbury will discuss some aspect of telephony.

The Educational Science Section, presided over by Prof. H. E. Armstrong, F.R.S., will consider reports on the teaching of mathematics, and the teaching of science in elementary schools. For the Tuesday afternoon a joint discussion with Section G, on the training of engineers, has been arranged. The Friday evening discourse will be by Prof. J. J. Thomson, F.R.S., on Becquerel rays and radioactivity.

Transmission of Electrical Disturbances.—The following note from G. W. de Tunzelmann reached our hands just too late for inclusion in our last issue:—"As Mr. Rankin Kennedy's difficulty, as set forth in his article on page 255 of the ELECTRICAL REVIEW for August 15th, may be shared by other readers, it may be worth while to point out that the fact of the electric waves, used in space telegraphy, resembling sound curves rather than those of light in their power of passing round obstacles, in no way militates against the accepted radiation theory. Sound waves pass round much larger obstacles than light waves because of their greater length, not because of the fact that the vibration in a light wave is transverse to the direction in which the wave front is travelling, while in a sound wave it is mainly longitudinal, nor because light waves consist of vibrations of the ether, and sound waves of vibrations of ordinary matter. The ether waves used in signalling over the considerable distances recently achieved by Marconi are several hundred feet in length, or some hundred thousand times that of light waves, and therefore undergo very much greater diffraction at the edge of an obstacle."

Obituary.—We regret to learn of the death of Mr. Thomas Nevins, an American millionaire, whose name has been somewhat prominently before electrical men in this country during the last few years because of his connection, as promoter, with several electric tramway and light railway undertakings. We may mention the Cheltenham and Cleeve Hill light railway which is now running, and the important Cheltenham, Stroud and Gloucester project which has attracted a good deal of attention lately. He was born in Ireland about 60 years ago, and at the age of 20 emigrated to America, where he rapidly became rich through his dealings in railway, gas and industrial enterprises. For years past the promotion of light railways possessed greater attractions for him than other branches of business.

Our readers will have learned with deep regret of the sad death of Mr. H. C. Digby Fearon, one of His Majesty's Inspectors of Factories, which occurred on the Wetterhorn on Wednesday last week. In a note headed "Generating Stations and the Factory Acts," ELECTRICAL REVIEW, July 25th (page 153), some remarks appeared as to the part played by the late Mr. Fearon in seeing how far the recommendations made by the Dangerous Trades Committee had been carried out in electrical works, also some suggestions made by him for the better protection of those engaged in electricity works. Mr. Fearon, together with his brother and two guides, were all killed by lightning.

The Board of Trade and Railways.—It is announced that Colonel H. A. Yorke, senior inspecting officer of railways, has been commissioned by the Board of Trade to proceed to America next month to report to the Board on the working of American railways, including both steam and electric lines.

Correction.—In Mr. F. W. Davies's article on "Armature Core Discs," on p. 301 of our last issue, in the formula

$$D_1 = \left(k - \frac{5}{p}\right) d,$$

it should have been stated that p = the number of magnet poles.

Calcium Carbide Reactions in the Electric Furnace.—The July issue of the *Elektrochemische Zeitschrift* contains an article by Gustave Gin, dealing with the chemical reactions by which calcium carbide is formed in the electric furnace. M. Gin points out that free oxygen is always present in the gases contained in the neighbourhood of the vertical electrode, while in the lower part of the furnace, calcium in the metallic or gaseous condition is to be found. The liberation of free oxygen during the reaction is the cause of the rapid consumption of the upper electrode at the point where it is plunged into the mixture of lime and coke, and this loss of carbon is not due, as is sometimes supposed, to oxidation by the oxygen of the air which may find its way into the furnace during the testing operations. M. Gin explains the formation of free oxygen and of free calcium in the furnace during the production of calcium carbide by the following equations:—

1. $CaO + 2C = CaC_2 + O.$
2. $CaC_2 + 2CaO = 3Ca + 2CO.$
3. $m\,CaC_2 + n\,CaO = (m + n)\,Ca + C_{2m}O_n.$

These reactions occur at different temperature zones in the furnace, and it is considered probable that other intermediate reactions also take place, in accordance with Van t' Hoff's law—the reactions becoming more endothermic in character—as the zone of maximum temperature is approached. The above equations explain why it is always necessary to employ more than the theoretical proportion of lime, in order to obtain a satisfactory yield of carbide in the electric furnace.

Canadian Niagara.—Our Niagara Falls correspondent says:—"Contractor A. C. Douglass is getting along nicely with the construction of the tunnel for the Canadian Niagara Power Company. This tunnel when completed will have a length of 2,200 ft., and of the entire length only about 248 ft. remain to be opened. About 900 ft. from the wheel-pit and 1,300 ft. from the portal a shaft was sunk to the required depth. Then from the bottom of this shaft excavation has been carried on in both directions, so that between the pit and the shaft about 48 ft. are still to be removed, and between the shaft and the portal there are about 200 ft. of rock to be taken out. Work is progressing from the face of the cliff at the portal as well as from the bottom of the shaft, so that good progress is made. Throughout the whole length of the tunnel the bottom bench is left to be taken out last, in order that the rock may be used in concrete and for filling. When started, the work of removing this bottom bench will go forward readily. Both the tunnel and the wheel-pit are to be lined with brick throughout. So far as the tunnel is concerned, Contractor Douglass expects to start laying brick about December, and this work will occupy the winter. Owing to the ice formation about the Horseshoe Fall during the cold weather, the granite work at the portal of the tunnel will not be commenced until next spring. The wheel-pit has reached a depth of about 600 ft., or one-third of its contemplated depth. The sides are being channelled, and ten cuts have so far been made. The length of this first section of pit is about 250 ft."

The Shop Clubs Act, 1902.—An Act of some interest to employers of labour received the Royal Assent on August 8th. According to the preamble, it has been placed upon the statute book for the purpose of prohibiting the "compulsory membership of unregistered shop clubs or thrift funds, and to regulate such as are duly registered." It was stated in the House of Commons by those who supported the Bill that it had become a practice with some employers of labour not only to insist upon their workmen joining the shop club attached to the employers' business, but to compel all those who entered their service to resign membership of any "foreign" friendly society or club. The Act under notice provides by Sec. 1 that it shall be an offence if any employer shall make it a condition of employment:—(*a*) That any workman shall discontinue his membership of any friendly society; or (*b*) that any workman shall not become a member of any friendly society other than the shop club or thrift fund. Sec. 2 makes it an offence for any employer to make it a condition of employment that any workman shall join a shop club or thrift fund, unless the shop club or thrift fund is registered under the Friendly Societies Act, 1896, subject to the provisions of this Act, and certified under the Act by the Registrar of Friendly Societies. A club or thrift fund, in order to qualify for a certificate under the Act, must (*a*) be such as to afford to the workman benefits of a substantial kind in the form of contributions or benefits at the cost of the employer in addition to those provided by the contributions of the workman; and (*b*) must be of a permanent character, *i.e.*, it must not be a society which annually or periodically divides its funds. Again, no member of any such shop or thrift fund shall, except in accordance with the provisions of Sec. 6 of this Act, be required to cease his membership in such shop club or thrift fund upon leaving the firm with which such club or fund is connected. In addition to observing the above rules, the Registrar must take steps to ascertain the views of the workmen upon the question of granting a certificate. He must be satisfied that 75 per cent. of the men are in favour of the establishment of a club before he grants a certificate. Further, provisions as to the rules to be observed by all such clubs are to be found in the schedule to the Act. If a workman who is a member of a shop club leaves his employment, he is to have the option of remaining a member of the club (in which case he is to take no part in the management thereof), or of taking the amount of his share of the funds, which amount is to be ascertained by actuarial calculation. The Act has no application to railways, and it does not come into operation until January 1st, 1902. Looking at the measure from a broad point of view, it appears to place one more barrier between employers and employed. Under existing law, it is impossible for a workman to contract out of the Workmen's Compensation Act, except with the approval of the Registrar of Friendly Societies. The new Act restricts an employer in making terms with those whom he wishes to have in his service. Numerous reasons suggest themselves why an employer should desire to have an interest in the shop club or thrift fund to which his men belong. As a subscriber thereto, he can exercise control over the administration of the fund; as one interested from both sides, he can see that the funds are not used so as to encourage malingering; and by prohibiting membership of more than one club he can do much to prevent malingering. The Act purports to deprive employers of all these privileges; they must take consolation from the fact that the Act only penalises them when they make certain conditions of employment; it does not venture to take away the right of dismissal, which can still be exercised by every employer without stating any reason.

Board of Trade and Tramway Regulations.—On the invitation of the Assistant-Secretary of the Board of Trade, representatives of Corporations and companies operating tramways had a meeting last Friday with representatives of the Board of Trade and of the Home Office at Whitehall Gardens, Westminster. The subject of the conference was the proposed Board of Trade regulations, especially with regard to carrying a red light on the rear of all cars. Mr. Young, of Glasgow, made the opening statement, and was followed by the representatives of Manchester, Newcastle, Liverpool, Cardiff, Hull, Leeds, &c., and also by Mr. Sellon, for the operating companies. It was pointed out that at night electric tramway cars of the present day present such a blaze of light that a red rear light was quite unnecessary, and, further, that on account of the adoption on all large systems of distinctive route colours, with lights at night coloured to correspond, a regulation requiring a red light on the rear of every car would be so confusing as practically to do away with the system of distinguishing route colours, which has been found so popular and convenient wherever adopted. Mr Cunninghame, as representing the Home Office, said, that his Department had no desire whatever to fetter or harass electric tramways, but quite the opposite. Their idea, if it could be carried out, was to have all road and street vehicles carrying a red light on the rear. He saw, however, from what had been put forward by this influential deputation that there might be a difficulty in making such a rule quite general, and in any case they would now consider whether electric tramway cars should be expected in the event of such a rule as proposed being adopted. He mentioned that in any case, the Home Office would not deal with the rules applicable to Scotland, so that his friends from the North might have any lights which suited them, so far as they were concerned.—*Glasgow Herald.*

Will.—The will of the late Sir Daniel Cooper shows a gross value of £150,531 2s. 2d., including personalty of the net value of £137,951 8s. 8d.

Appointment Vacant.—Shift engineer for Buxton electricity works.

THE CENTRAL STATION ENGINEER.

MR. W. B. WOODHOUSE, A.M.I.Mech.E., A.M.I.E.E., has been appointed resident engineer at the Neptune Bank power station of the Newcastle-upon-Tyne Electric Supply Company.

Out of 112 applicants for the position of assistant electrical engineer at Oldham, Mr. S. CAZEAN, of Rochdale, has been appointed.

Mr. A. F. DOWDEN, of Southampton, has been appointed junior shift engineer at Croydon electricity works.

Mr. WM. THOMSON, of Paisley, has been appointed manager of the Gas and Electricity Works at Kendal, at a salary of £225 per annum, with house and taxes free. There were 37 applicants for the post.

NEW COMPANIES REGISTERED.

Slough and Datchet Electric Supply Co., Ltd. (74,605).—This company was registered on August 12th, with a capital of £50,000 in £1 shares to carry on at Slough and elsewhere the business of an electric light and power company, to construct, lay down, establish, fix, and carry out all necessary

cables, wires, lines, accumulators, lamps and works, to generate, distribute and supply electricity for the purposes of light, heat or power, and to carry on the business of manufacturers of and dealers in all apparatus, goods, appliances and things used in connection with the above, electric launch and electric carriage builders and fitters, &c. The first subscribers are:—H. L. Prior, The Priory, Datchet, J.P., with 500 shares; T. Moseley, Bangor's Park, Iver, Bucks., J.P., with 500 shares; H. R. de Salis, Ivy Lodge, Iver Heath, Bucks., J.P., with one share; A. A. Somerville, Eton College, Windsor, assistant master, with 500 shares; E. Riley, Marton, Bucks., gentleman, with one share; A. H. Thornton, Bank House, Windsor, banker, with 500 shares; A. W. Shipley, River Bank, Datchet, brewer, with 500 shares; C. C. Higgins (Capt.), Upton Park, Slough, with 500 shares; and C. J. Jackaman, Highfield, Slough, C.E., with 500 shares. Minimum cash subscription, £12,500. The first directors are T. Moseley, H. L. Prior, A. A. Somerville, A. H. Thornton, A. W. Shipley, C. J. Jackaman, and C. C. Higgins; qualification, £500; remuneration, £400 per annum divisible, after payment of 4 per cent. dividend. Registered office, 11, Mackenzie Street, Slough, Bucks.

Worcester Electric Traction Company, Limited (74,698).—This company was registered on August 22nd, with a capital of £120,000 in £5 shares, to carry on in the United Kingdom, or elsewhere, the business of electrical engineers, electricians, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—C. H. Godward, 198, Park Road, Crouch End, N., secretary; R. N. Gray, Donington House, Norfolk Street, W.C., secretary; F. C. Cocking, Norfolk Villa, 69, Friern Road, Dulwich, registrar; C. L. Robertson, 48, Bullingham Mansions, Kensington, W., director; H. Collbourne, Donington House, W.C., secretary; G. E. Medhurst, 208, Dulwich Rise, S.E.; secretary; and H. Wingsford, 77, Queen's Road, Wimbledon, S.W., secretary. No initial public issue. The number of directors is not less than three nor more than seven, the subscribers are to appoint the first; qualification, one share; renumeration, £50 per annum each, to be increased according to profits. Registered office, Donington House, Norfolk Street, Strand, W.C.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—Calcutta Tramways Company, Limited.—Further issue of 35,000 shares of £5 each, £2 10s. paid. Also to allow the following securities to be quoted in the Official List:—National Electric Wiring Company, Limited.—100,000 ordinary shares of £1 each. National Telephone Company, Limited.—£1,000,000 preferred stock, in lieu of the 200,000 preferred shares of £5 each, Nos. 590,001 to 790,000 now quoted.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.	Total to date. Am'nt.	Inc. or dec.	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Aug. 22	794	— 59	18,315	+ 3,365	12¼	13¼
Blackpool and Fleetwood	,, 23	1,912	—509	10,561	— 1,263	7½	7½
Bristol Trys. & Car. Co.	,, 22	4,995	+872	—	—	—	—
British Elec. Trac. Co.:—							
Devonport	,, 15	516	+ 92	13,598	+ 490	5	5
Dudley—Stourbridge..	,, 15	859	+106	24,018	+ 3,286	18¾	18¾
Gateshead	,, 15	886	+205	23,378	+ 3,620	10½	9½
Gravesend	,, 15	219	—	513	—	3½	—
Greenock—Pt. Glasgow	,, 15	709	+528	15,971	+ 9,643	7¼	7¼
Hartlepool	,, 15	388	+118	8,175	+ 997	6¾	4¾
Kidderminster	,, 15	120	+ 9	4,021	+ 16	4½	4½
Merthyr	,, 15	208	— 35	6,609	— 1,258	3	3
Middleton	,, 16	386	—	6,407	—	8¼	—
Oldham—Ashton ..	,, 15	628	+ 50	16,899	+ 688	8	8
Poole	,, 15	389	+ 42	8,108	— 115	3¾	3¾
Potteries	,, 15	1,389	+134	47,799	+ 1,855	28¾	28¾
Southport	,, 15	423	+173	8,020	+ 2,779	5½	5½
South Staffordshire..	,, 15	698	— 78	25,126	+ 315	21½	22½
Swansea	,, 15	555	— 13	15,294	+ 1,168	5½	5½
Taunton	,, 15	160	—	2 143	—	1½	—
Tynemouth	,, 15	505	+118	9,223	+ 886	3¾	3¾
Wolverhampton Dist.	,, 15	274	+177	5,688	+ 3,803	10¾	2¾
Weston-super-Mare..	,, 13	357	—	3,271	—	2¾	—
Central London Railway	,, 23	5,482	+ 73	51,582	+ 4,966	6	6
City and S. London Ry.	,, 24	2,645	+948	22,141	+ 7,532	6¼	4¼
Doncaster Corp. Trys. ..	—	—	—	716	—	5½	—
Dover Corporation Trys.	,, 23	321	— 15	7,374	+ 103	3	3
Dublin United Trys. ..	,, 22	4,946	—390	89,376	— 1,025	46	46
East Ham Tramways ..	,, 23	491	— 12	—	—	5	4¾
Glasgow Corp. Trys. ..	,, 23	11,685	—1,789	141,728	— 5,477	53¼	44¼
Liverpool Overhead Ry.	,, 24	1,670	—108	13,188	— 946	6½	6½
Newcastle Corp. Trys. ..	,, 23	2,794	—	—	—	35	—
Sunderland Corp. Trys.	,, 24	1,326	—176	25,873	+ 2,083	17¼	17¼

STOCKS AND SHARES.

Wednesday Evening.

With Consols weakened by influences alien to the market as a rule, there has come something of a check to general investment business. The Home Railway department finds it difficult to prevent relapses in the presence of flat Consols, and although the traffic returns are good on the whole, no public support is accorded to stocks in this section. But electric securities form, as they frequently do, the exception. In the telegraph market business shows signs of broadening out, but electric supply descriptions are a little quieter, while the tendency of prices keeps good. Rather more trade is passing in some of the industrial shares, and a few rises are the result.

City and South London Ordinary is a point to the good, and now that Waterloo and City is marked *ex* div., buyers may be tempted by the comparative cheapness of the quotation. A 3 per cent. stock at 92 pays £3 7s. 6d. per cent. on the money invested, and with security as good as the Waterloo and City, it is possible that attention may be again directed towards it when the gilt and silver-edged markets return to something like a normal condition. The small amount of the stock—there is only £540,000 of it—precludes any active market, but when the price begins to move, it generally does so by points at a time.

Incidentally, it may be noted that Lancashire and Yorkshire Railway stock has risen this week upon the strength of the company's reported determination to electrify that part of its line which runs between Manchester and Liverpool, with a view to meeting the competition threatened by the mono-rail. It seems a pity that the great steam lines should refuse to move in the matter of electric traction until forced to do so by the appearance of more enterprising spirits.

London United Tramways 4 per cent. Debenture is changing hands at a slight fraction below 110, while the 5 per cent. Preference shares keep at £11. The partly-paid are quoted at 8¼, which is 15s. premium, as against the £1 premium of the fully-paid shares. Dublin Trams at 12 are a very quiet market, and business in them on both sides of the Irish Sea has become reduced to a minimum. British Electric Traction Preference have scored a small rise, and now stand at 12⅜. British Columbia Electric Railway Preference, although quoted at 9¼ to 9¾ in the Official List, are really weaker, and sellers have hard work to get a bid of 9. It is the sending-out of these fancy figures which drags the Stock Exchange Official List into disrepute, and causes the investor to regard its pages with more scorn than it deserves—which is saying a great deal. Great Northern and City Preference, at 8¼, are a shade easier, there being a seller of 100 or 200 shares in the market, which is at all times a limited one.

Notwithstanding the apparent lack of variation in the electricity supply list, there are several prices really harder than they were a week ago. Charing Cross Ordinary have recovered from their previous dulness, and are again 9¼. The City Undertaking Preference keep about ¼ discount to par. Chelsea Ordinary have also improved fractionally, a buyer of the Preference turning his attention to the former when he found he could not get what he wanted in the latter. There is a better tone in Kensingtons, but it takes an order in a very small number of shares to move the price of these. Nothing further has transpired with regard to the probable upshot of the Metropolitan Electric case, but the recent selling is over, and the price is actually better, although nominally unchanged. On the other hand, Notting Hill shares have receded a trifle upon a small parcel coming in for sale, and London Electrics lost some of that unusual strength which they displayed last week upon the issue of the company's report. South Londons are rather wanted, and so are Electric Constructions; the Debenture stock shows a slight improvement.

A feature of the last few days has been the steady demand for some of the little-known best provincial electric supply shares. Dealing in these is necessarily a matter mainly of negotiation, but just recently the inquiries have all had purchases as their object, and a fair amount of business is doing in them. Quotations remain steady, with no sensational change.

In pointing out that Globe Telegraph and Trust issues are harder, the Preference quotably so, an indication is given as to the tone of the telegraph market altogether. Eastern Ordinary has at last been put up, although only to the extent of 1 per cent. The ridiculously wide margin quoted in the Official List does not, however, give a fair idea of the real price, which is about 124. Eastern Extensions have failed so far to move in sympathy with the other stock. Cuba Telegraphs again improved their position, and Commercial Cable displays a five-dollar rise, following upon the way in which Wall Street is putting up American shares of all kinds. Submarine Cables Trust Certificates are unchanged, and Anglo-American Deferred even fell ¼, upon realisations by some proprietors who were thankful to get out upon any activity. Direct Spanish Telegraph Preference are dull at 7½. One or two of the National Telephone issues have hardened a little, Third Preference merely recovering last week's relapse. The better tone for telegraph stocks prompted an inquiry for Telegraph Construction shares, and a rise of £1 has ensued.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Aug. 20th.	Closing Quotation Aug. 27th.	Business done during week ended Aug. 27th, 1902. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 ...	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	47 — 50	47 — 50	...	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	92 — 94	93½	92
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7½— 8	7½— 7⅞	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3½— 4 xd	3½— 4	...	...
18,333,300$	Commercial Cable	$100	8 %	8 %	8 %	155 —165	160 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96½	59½
16,000	Cuba Telegraph	10	7 %	4½ %	4 %	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	13 — 14	13⅛	12⅞
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	7 — 8	7 — 8	7 1/16	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 11	10 — 11	...	...
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	98 —101	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	117 —127	118 —128	122½	119½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	87 — 90	88 — 91	89½	88
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —112	108 —112	108½	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	11½ - 12½	11½ - 12½	11⅝	11 9/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —112	107 —112	...	...
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	98 —101	98 —101	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103 %	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9 — 10	9 — 10	9⅝	9½
160,042	Do. do. 6 % Pref.	10	...	...	...	12½ - 13½	13 — 14	13 1/16	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	15 %	15 %	25 — 27	25 — 27	...	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 — 106	102 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	½— ⅝	½— ⅝	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	5 %	5 %	½— 1	¾— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	92 — 96	92 — 96	94½	92½
200,000	Do Pref. shares	2	...	3½	3⅝	4⅝— 4⅞	4⅝— 4⅞	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	54 — 58	54 — 58	56½	55
15,000	Do 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞ - 5⅛	4⅞ - 5⅛	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	96 — 99	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	1⅛— 1 1/16	1 1/16	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	5 %	6½ - 7⅛	6½ - 7⅛	7⅝	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	112½	...
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜— 5⅛	4⅜— 5	5 7/16	5½
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5	4⅜— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	97 —100	97 —100	...	...
207,980	Western Telegraph, Ltd., Nos. 1—207,980	100	...	...	...	11½ — 12½	11½ — 12½	12 1/16	11 1/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do do. 4 % Deb. Stock Red.	10	5%	4 %	...	97 —100	97 —100	97½	...
88,321	Do. do. do.	10	...	...	...	¼— ½	¼— ½	...	...
34,563	West India and Panama Telegraph	10	...	...	...	4½— 5½	4½— 5½	...	...
4,569	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	3 — 4	3 — 4	...	...
80,000£	Do. do. do. 6 % Cum. 2nd Pref. ...	100	...	...	...	99 —102	99 —102	...	...
	Do. do. do. 5 % Debs., Nos. 1 to 1,800								

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106	103 —106	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9½ - 10	9½ - 10	9⅝	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9½ - 10	9½ - 10	9⅝	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8½ - 9½	9 — 9½	9⅝	5 9/16
50,000	Do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106	...
84,000	*Chelsea Electricity Supply, Ord.	5	6 %	6¼%	4 %	5½— 5⅝	5½— 5⅝	5½	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	9 — 10	9 — 10	9½	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅝	12⅝
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
200,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	102 —105	103 —106	105	103
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9⅛	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 12½	11½ — 12½	12 1/16	11 1/16
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 —112	109 - 112	111	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	6¼
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6¼	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	107 —110	108	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½ - 11½	10½ - 11½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅞— 2⅛	1⅞— 2⅛	2	1 1/16
49,840	Do. do. do. 6 % Pref.	5	...	...	...	5 — 5⅛	4⅞ - 5⅛	5 1/16	5
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 — 99	96 — 99	97	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15 — 16	15 — 16	15½	15⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	Stock	...	...	...	108 —112	108 —112	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	...	...	...	...	90 —102	99 —102	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½ - 14½	13½ - 14½	14½	13⅞
40,000	St. James's and Pall Mall Electric Light, Ord. ...	Stock	...	...	...	14½— 15½	14½— 15½	15	...
20,000	Do. do. 7 % Pref., 20,031 to 40,030	10	7 %	14½%	14½%	8½— 9½	8½— 9½	9½	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	5	14½%	7 %	7 %	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	7 %	...	...	1⅝— 1⅞	1⅝— 1⅞	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,800	South London Electricity Supply, Ord	5	...	...	...	2½— 3	2½— 3	2 13/16	2 7/8
109,518	Westminster Electric Supply, Ord.	5	12 %	10½%	10½%	11 — 12	11 — 12	11 9/16	11 7/16

* Subject to Founders Shares.
Unless otherwise stated all share are fully paid.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation August 20th.	Closing Quotation Aug. 27th.	Business done week ended Aug. 27th, 1902. Highest.	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	5¼%	...	4 — 5	4 — 5	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 88	83 — 88	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	12½— 13½	12½— 13½	13	12⅝
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12¼— 12⅝	12½— 13	12 13/16	12½
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	125⅝	125
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7¼— 7⅜	7¼— 7⅜	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 6	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref. ...	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	1½— 1⅝	1½— 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1½— 2	1½— 2	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	93 — 98	93 — 98	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	15½— 16½	15½— 16½	16¼	15½
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5⅝— 6⅛	6 1/16	5⅞
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106 xd	103 —105	105	104½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	104 —107 xd	104 —107	106	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	103 —106	103 —106	105¼	105
855,000	City and South London Railway	Stock	1½%	1½%	2 %	71 — 73	72 — 74	73¼	72⅝
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	7½%	2½— 3 xd	2½— 3	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½— 2½	1½— 2½	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	74 — 78	74 — 78	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	78 — 83	78 — 83	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅞— 2¼	1⅞— 2¼	1⅞	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	2 9/16	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —101	99 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	5 %	5 %	9⅞— 10¼	9⅞—10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅝	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 5⅝	5½— 5⅝	5⅝	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½— 21½	20½— 21½	20⅝	...
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅝%	3⅛%	1¼%	4 7/16— 4 11/16	4⅜— 4½	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	9½— 10¼	9½— 10¼	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	14½—15½	14½— 15½	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	37 — 40	38 — 41	39¼	38⅜
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93 xd	90 — 93	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅛.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅝—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, August 27th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	22/-	22/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	£38 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£37 10	£37 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	5d.	5d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	109/-	109/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£8 5	£8 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb.	3½d.	3½d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £140	£40 to £140	..
p Brass (rolled metal 3" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn)	per lb.	7d.	7d.	..
c „ Wire, basis ..	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
„ „ (solid drawn) ..	per lb.	9d.	9d.	..
p Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
p Copper Sheet	per ton	£69	£69	..
p „ Rod	per ton	£69	£69	..
c „ (Electrolytic) Bars ..	per ton	£68	£68	..
c „ „ Sheets ..	per ton	£75	£75	..
c „ „ Rod ..	per ton	£68	£68	..
c „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/8	..
h Gutta-percha fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	3/1	3/1	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	53/2	52/2	1/- inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 2 6 to £11 5	£11 2 6 to £11 5	..
g „ „ Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
c Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	£68	..
i „ „ in bars		£68	£68	..
g Tin, block	per ton	£125 to £126	£128 to £129	£3 dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 18	per lb.	1/7	1/7	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/18s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j „ 3 ply 10 lbs. Russian	per lb.	4½d.	5½d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¾d.	4¾d.	..
j „ 180 lbs. Jute rove	per ton	£11 15	£11 15	..
h Zinc, Sh's. (Vielle Montagne brd.)	per ton	£23	£23	..

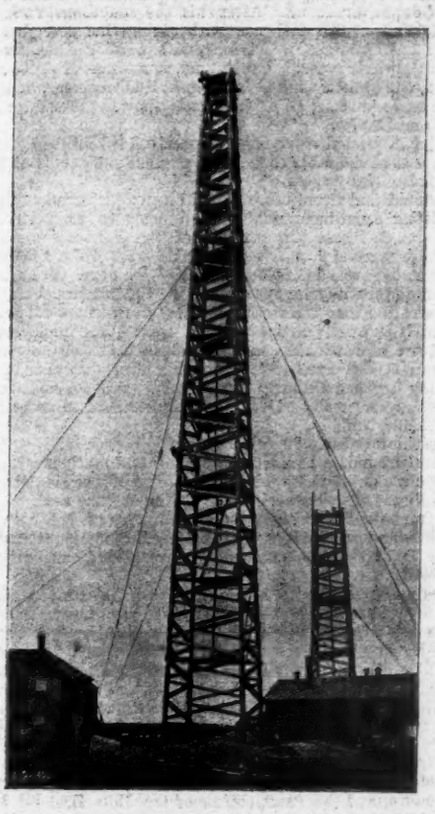
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs F. Wiggins & Sons. e Messrs Frederick Smith & Co

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare, [Co., Ltd. h Messrs. Edward Till & Co. i Messrs Bolling & Lowe. j Messrs Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

THE MARCONI STATION AT CAPE BRETON.

The *Scientific American* of August 9th contained an illustrated article on the new Marconi station for telegraphing across the Atlantic. The European station is situated at Poldhu, Cornwall. On the American side of the ocean the station used in the original experimental work was erected on a lofty point at the entrance to St. John's Harbour, Newfoundland; but on account of the opposition of the Anglo-American Telegraph Company, Marconi abandoned that site, and selected two new locations, one on the easterly coast of Cape Breton, Nova Scotia, and the other at Cape Cod, Massachusetts. The station at Glace Bay, Cape Breton, is located on a promontory



One of the 215-ft. Towers, Showing Details of Construction.

of land, whose surface lies about 70 ft. above mean high water. The plant consists of four huge towers for carrying the vertical wires, and a group of one-storey buildings arranged at the base of the towers, in which are contained the powerful electrical plant which has been specially constructed for the station. The four great towers, as shown in the illustrations, take the place of the familiar single mast that is used where transmission is to be conducted over

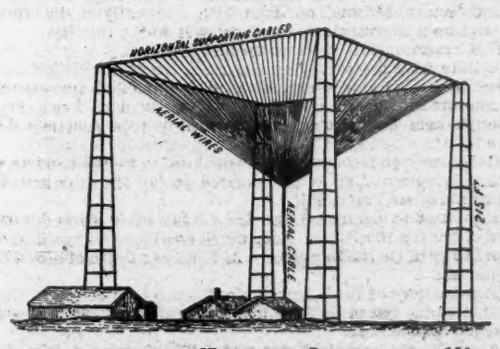


Diagram Showing Method of Stringing the 150 Aerial Wires at the Marconi Cape Breton Station.

moderate distances. The necessary height for the vertical wires has been attained by the erection of four braced wooden towers, each 215 ft. high, at the four corners of a square which measures about 200 ft. on a side. Each tower consists of four legs, built up of 3 × 12-in. plank, the legs being braced together on each face of the tower by 3 × 9-in. braces. The planking of which the legs are built is laid up so as to break joints as much as possible, and secure the approximate strength of a solid 12 × 12-in. stick. The legs are spaced 30 ft. from centre to centre at the base, and 9 ft. from centre to centre at the top platforms. The foundation of each tower consists of a mass of concrete formed in a hollow square, in which are embedded the 12 × 12-in. sills and the first panels of the lateral bracing. In section this concrete mass is 6 ft. in width by 8 ft. in depth, the external dimensions of the foundation being 36 × 36 ft. and the internal dimensions 24 × 24 ft.

The experience obtained with previous attempts to carry a set of lofty aerial wires, more particularly that at Cape Cod, which was wrecked in a heavy gale, proved that the weakest feature in those structures was the system of guy-ropes with which they were held in position. The fall of the Cape Cod structure was due to the parting of the extreme weather guy-ropes, the method of tying the towers adopted having been such that practically the whole strain fell upon a few stays. In the present case the towers are tied in such a way that the stress on each tower will be transmitted directly to its own set of cables, every one of which will be doing useful work. The wires are carried from three points on the towers (the lower and upper third and the summit), all wires having an inclination of 45°. The ropes are all made of the best plough steel, the majority of them being 2½ in. and a few 3 in. The method of carrying the aerial wires upon the structure is as follows:—Four 3-in. cables are strung from platform to platform at the top of the towers, as shown in the accompanying diagram, and from these cables depend 150 aerial wires. These are drawn together and united in the centre of the tower into a single cable, which descends vertically to enter the transmitting and receiving house below. The average length of the aerial wires before they meet in the common central cable is about 140 ft.

PACIFIC CABLE SURVEY.

Mr. R. E. Peake's book on "Deep-Sea Sounding in the Pacific" consists of extracts from the engineers' (Messrs. Clarke, Ford and Taylor) report on the Pacific Cable Survey, with Notes and Description of the Deep-Sea Deposits by Sir John Murray, K.C.B., LL.D., D.Sc., F.R.S.

The period occupied by the work was from May to August, 1901, and the ship used for the purpose of the survey the ss. *Britannia*, a steel twin-screw steamer of 1,554 gross tons and 1,200 I.H.P. A review of the last important survey upon which this vessel was employed—that between the English Channel to the Azores and New York, &c., in 1899—will be found in the Electrical Review for May 10th, 1901, Vol. xlviii., p. 820.

The account of the present survey is set forth in a brief but comprehensive manner, commencing with a description of the ship and its apparatus, which appear to be of a kind to secure the best results.

The operations of sounding, &c., commenced on May 18th, 1901, two days after the *Britannia* had left Sydney. This vessel was under the command of Capt. J. E. Leach, Mr. C. W. Clarke being the contractors' engineer on board, and Mr. R. E. Peake having joined the vessel at Sydney to supervise the carrying out of the survey on behalf of the Pacific Cable Board.

Off Southport, the point nearest to Brisbane selected for the landing of the cable to be laid to Norfolk Island, some soundings were taken to find the character of the bottom, which proved to be of sand, dead coral and small shells. Then profile soundings were carried out to deep water, a very regular slope being formed from the 100-fathom line at 23 miles from shore to the depth of 2,650 fathoms at 77 miles out. The character of the bottom was similar to that nearer the coast, and it would appear that the upper part of the slope is of ordinary coral formation. Farther out, however, from the 200 fathoms to 2,200 fathoms, globigerina ooze is found; beyond that depth the deposit becomes a red clay.

A strong southerly set of current was met with during this first series of profile soundings, so that on sounding back to the coast a line was chosen north of the cable route, these soundings corresponding closely to those taken to the southward.

After visiting Brisbane the sounding work was resumed from the position of the last deep cast on the direct route to Norfolk Island, a depth of 2,470 fathoms being reached. After this, and at a distance of 112 miles from the coast, a depth of 824 fathoms was found; further sounding to the southward showed a shoaling to 228 fathoms. After this several others, all of which indicated the existence of a range of submarine mountains extending for 40 miles south of direct cable course, were made. Upon exploring the northern end of this mountain range a narrow gully was found running through it in a north-east direction, with a hard and irregular bottom.

This discovery led to the abandonment of the route originally chosen for the cable in view of the bad ground in this gully and the strong current, which might have caused the cable to be laid across the range. The southern part of the elevation was then examined, and its termination found, with water deepening to 2,300 odd fathoms, at about 30 miles from the shoalest depth or crest of the range, with a sounding of 220 odd fathoms.

A summary of these operations shows that at 112 miles from land a range of mountains was met with extending for 40 miles south of the direct cable route between Southport and Norfolk Island, and probably as far to the north if the gully is not considered. The gradients on the west side are very steep, showing a rise in one place of 12,000 feet in 16 miles. This range has been named the Britannia Hills.

After completing a line of soundings between the last of the

profiles and the position of the 2,346 fathoms, the normal depth south of the range, and finding an average depth of 2,500 fathoms, the sounding line was resumed towards Norfolk Island, the results showing a good level bottom, with a practically uniform depth of 2,500 fathoms as far as latitude 25°.53′S, longitude 157°.42′ E., about 110 miles from the south extreme of the Hills, at which position, about 1,500 fathoms was struck and followed by a long stretch of shallower water.

After leaving the "Hills," very strong Northerly currents, it is stated, were encountered, the effect of this causing the soundings along what is termed the 1,500-*fathom* plateau to be in some cases unnecessarily close together, owing to ship being set towards the sounding previously taken.

From an inspection of the chart, we do not find this 1,500 fathom plateau to be very evident upon taking a comprehensively general glance, but the figures are so small and blurred in the printing, that it is difficult to decipher them. The soundings shown appear to be more like 1,600 to 1,700 fathoms between the termination of the 2,500-fathom level (latitude 25°.53′S and longitude 157°.42′ E.), and the commencement of the shoaler ground of between 700 and 900 fathoms in latitude 29°.0′S., longitude 160°.30′E. (approximate).

The wide Pacific does not appear to have always been in a smiling mood, for bad weather, in the guise of a N.W. gale and heavy sea, interfered with progress of work, but a resumption of sounding after a day's delay brought a change of depth from 1,500 (?) fathoms to 800 fathoms in latitude 29°S., longitude 160°.30′E., which continued with slight variations during two days, when deep water was struck again in 1,900 fathoms.

The shoal area passed over (it is stated) extends for about 220 miles along the cable course, rising from 850 fathoms on its Western side to about 700 fathoms in its centre, and then falling to the eastward on the same gradient.

From latitude 29° S., longitude 164°.20′ E. approximately, the soundings showed level ground to latitude 29°.6′ S., longitude 165° E., deepening at this position to over 2,000 fathoms, and the depth afterwards decreasing gradually to about 1,400 fathoms, latitude 29°.3′ S., longitude 165°.25′ E. This shallower depth was considered to be the shoulder of a hill, crossed by the cable route; the soundings then showed over 1,800 fathoms, and continued so for some 30 miles (? 90 miles), to latitude 29° S., longitude 168° E., approx.

Slight currents, but strong S.E. winds and sea, appear to have necessitated considerable allowances in the courses steered while sounding; the star and other observations taken at intervals, however, showed that the positions aimed at were correct.

A maximum depth of over 1,900 fathoms had been reached, latitude 25°.5′ S., longitude 166°.44′ E., before shoaling depth again on approaching Norfolk Island, which was sighted 40 miles off, the depth at this point being over 1,200 fathoms, globigerina ooze being generally found in all the bottom samples.

Anson Bay, at the N.W. corner of the Island, was selected as the landing place for the cable, this choice necessitating further soundings to the north of those already taken. This extension of the survey proved satisfactory, and, moreover, practically the whole ocean floor between Queensland and Norfolk Island was found to consist of globigerina ooze, the best possible bed for a cable.

A rather steep ascent was found off Anson Bay to the 100-fathom line, the change of depth between the 200-fathom and 50-fathom lines taking place in about one mile.

The nature of the bottom on the banks on this side also consists of sand and coral *débris*.

The distance between landing places over the route selected, including the detour made to avoid the Britannia Hills, it is stated, is 778 miles, being an increase of 12½ miles over the direct route.

To sum up the depths along the cable line. It appears that the Queensland Bank extends for some 23 miles, then the Continental slope to 2,200 fathoms' depth a further 51 miles, and then a stretch of level ground for about 160 miles, with an average depth of 2,500 fathoms. Then another stretch of 130 miles, with a depth of from 900 to 700 fathoms. From this latter point the depth increases to 2,000 fathoms for 73 miles, then rises to 1,400 fathoms for 23 miles, falls to 1,950 fathoms in 77 miles, and from thence, in 49 miles, rises gradually to the foot of Norfolk Island Bank.

This summary in the report does not touch upon the 1,500-fathom plateau mentioned in the body of the text of the report, nor, by a reference to the chart, does this appear very clearly, the depth shown being from 1,600 to 1,700 fathoms.

On June 18th the survey for the Norfolk Island (New Zealand section) was proceeded with, the route, as projected, going due south until clear of Philip Island, then south-east to the edge of the bank over 29 miles of shallow water—*i.e.*, 30 to 40 fathoms' depth, with a bottom of broken coral and fine sand. Near the edge of the bank live coral was found.

A curious feature is recorded in the fact of very high bottom-temperatures being found over this stretch of soundings, all being within the range of 65°, to 67·3° in a depth of between 32 and 103 fathoms, the temperature of the air being only 65°.

Rough weather again interfered with the operations, but some bottom-temperatures were obtained on the 100-fathom line, which show a great change from temperatures observed just previously, those now taken registering 62·5° in 116 fathoms to 63·8° in 42 fathoms' depth. These temperature variations are attributed to varying currents, which extend to a depth of over 100 fathoms.

At a distance of 25 miles from the 100-fathom line a sounding gave 1,200 fathoms, and at 10 miles south from this a depth of 790, and then 720 fathoms was found.

The exploration of this shoal ground was interrupted by bad weather, but eventually a patch was located apparently in the shape of a hill, standing alone surrounded by water of 500 fathoms greater depth.

It is remarked that in the ordinary course of sounding this patch might easily have been missed, and as its position was close to the cable route, the value of the zigzag system of sounding within a band of varying width is clearly shown.

Again, it appears that the results of the soundings first taken, down to 1,200 fathoms, were not sufficient to show the irregularities of the lower portion of the bank. The slope, it is remarked, is probably very gradual and even, down to 800 fathoms, but from this depth to 1,500 fathoms it is broken and irregular, and resembles somewhat the ground around the Azores group.

The south-east side of the Norfolk Island bank, it is shown, differs from the north-west side, as the slope near the 100-fathom line is gradual. The irregular ground was apparently passed at about 70 miles from the landing place, at which distance therefrom 1,583 fathoms' depth was found. After this the soundings varied from about 1,600 to 1,900 fathoms, with globigerina ooze, but then a depth of 1,200 fathoms was struck, with hard bottom, five miles north of the cable route. Continuing, soundings of 2,000 fathoms and over, were taken, the greatest depth, 2,438 fathoms, being found at noon on June 25th; all of these casts showed globigerina ooze in the bottom samples.

The depth shoaled after this to nearly 1,400 fathoms, with hard ground, east of the cable route, then gradually it decreased to 1,100 fathoms also hard bottom.

It is stated that strong currents had been experienced while taking these latter soundings, making it difficult to fix positions, but endeavours to locate the position of the hard patch mentioned above were successful, and at a mile south-west of the 1,100 fathoms, another cast gave 1,105 fathoms, globigerina ooze. Then a run of 5 miles to the south-west gave a depth of 1,250 fathoms, with the same character of bottom. The cable course was altered to pass these undesirable patches, but the course of a cable line hardly ever runs smooth, and in continuing, the depth shoaled, the bottom proving to be of hard rock in 800 odd fathoms, this hard character of ground extending for some distance. Another change in the cable route was consequently necessitated taking the cable farther away from the New Zealand bank.

From this for nearly 80 miles on the approach to New Zealand very level ground, at an average depth of 1,100 fathoms, was found, and for close on 40 miles towards the end of the line they varied but a fathom or two between one sounding and the next.

It is remarked that the general character of the bottom from Norfolk Island to the foot of the New Zealand bank may be considered favourable, and, with a few exceptions, excellent as a bed for the cable.

Gales again appear to have interrupted the even tenour of the work, first from the north-east for three days, and then a westerly gale for five days, the ship arriving at Auckland on July 7th.

The landing place selected was Harris Green, Doubtless Bay, but bad weather prevented any further sounding work until after July 13th, when it was discovered that a spit runs out to the eastward from the New Zealand coast, a depth of 168 fathoms being found near to where sounding operations had been discontinued on the 6th. A better idea of the contour of this spit can be gained by reference to the chart appended to the Report.

Satisfactory soundings were now obtained along the proposed cable route, and the examination of the New Zealand bank was completed.

Then another attempt was made to discover the extent of the hard patch, where a depth of 1,100 fathoms was found, two soundings being taken, one five miles to the south-east and another two miles to the north-east of the 1,100-fathom position; the result was, in the first place, 1,135, and in the latter 1,278 fathoms, soft bottom, being indicated.

Another examination of hard ground in the vicinity of a sounding of over 1,300 fathoms was made; two more taken here at five miles apart showed good bottom of globigerina ooze, and it was evident that the bad ground covered but a small area.

Some bottom-temperatures obtained near to the edge of the Norfolk Island bank again showed 60·9° and 61° respectively, as compared with 65° and 67·3° found on June 18th, this verifying the former assumption that a varying current prevails in the locality.

This completed the ship's work on this section.

On July 16th the survey of the route for the Norfolk Island—Suva, Fiji cable followed on with an attempt to find a way across a narrow stretch of shoal ground to the westward of Anson Bay in order to save heavy cable, and then keep to a moderate depth round the north end of the bank to set a course direct to Fiji.

This essay was, however, unsuccessful owing to bad and irregular ground being found, so it was decided to lay the cable across the bank on a direct line to Fiji.

Soundings to determine the fall of the bank showed a steep gradient at the 100-fathom line, which was crossed at a distance of 19 miles from the landing place. At 26 miles a depth of 535 fathoms was found.

The character of the bottom up to this point proved to be similar to that on the Queensland section, sand and coral *débris* emerging into globigerina ooze.

Another steep gradient was met with, showing a fall of 675 fathoms in 2¼ miles, this being unlike any previously found. Bottom specimens showed globigerina ooze throughout.

On July 7th depths of between 1,500 and 1,800 fathoms were found, but the water shoaled to 1,240 fathoms at a position directly on the cable route, and in consequence of this the route was diverted. Then a narrow depression with about 1,800 fathoms was crossed, followed by a ridge with about 1,500 fathoms' depth. After this the depth increased gradually to 2,200 fathoms, which, it was judged from previous charted soundings, would prove to be the normal depth; the runs were therefore increased from 10 to 15 miles between each cast.

This conclusion, however, was soon proved to be erroneous, as at a distance of 13 miles from a charted depth of 2,132 fathoms, a sounding now showed only 842 fathoms. This discovery causing a further diversion of the cable route.

A closer examination of this shoal patch revealed the existence of a hill surrounded by deep water, as in a similar case mentioned on the Norfolk Island—New Zealand route survey.

The importance of taking soundings at short intervals for cable-laying purposes is mentioned, as those taken on previous expeditions at 40 to 50 miles apart gave no indication of shoal ground here.

The cable route being again altered, sounding was resumed on the new line, the greatest depth giving 2,408 fathoms, the previous results varying between 2,000 odd and 2,300 fathoms, slightly shoaling to about 1,900, then deepening to 2,300 and 2,408 fathoms.

All these soundings showed globigerina ooze.

Bad weather had retarded the work somewhat from July 19th to 22nd, but fine weather setting in operations were accelerated, depths of over 2,000 fathoms being the rule, and bottom specimens showing a large percentage of manganese with pumice, &c.

A large number of soundings were taken to the eastward of Conway Reef, which lay within a short distance of the direct route from Norfolk Island to Fiji, the ground being found rocky and irregular, compelling a further divergence of the cable route.

The chartlet opposite page 20 shows very distinctly the work done in this vicinity, an area of over 100 miles having been examined before the route could be decided on.

(To be continued.)

THE REQUIREMENTS FOR THE PARALLELING OF ALTERNATORS AS VIEWED BY THE ENGINE BUILDERS.*

By HENRY E. LONGWELL.

(*Concluded from page* 325.)

We have been told that this synchronising force is what makes paralleling possible, and that the more we have of it the better; we are told that it checks the displacement of the rotating parts of the engine resulting from the irregular crank-pin effort, and that with great synchronising power in the generators it requires a decided effort on the part of the engines to prevent the generators running well in parallel.

This looks so plausible that we have for years accepted it against the evidence of our senses, when, in fact, there is just one small grain of truth in it—*i.e.*, that some synchronising force is necessary to make paralleling at all possible.

Synchronising force is not one of the few good things one cannot get too much of.

Synchronising force cannot pull two generators into phase and hold them there any more than the force of gravity can pull an ordinary pendulum to the vertical position and hold it there. If we displace an ordinary pendulum to one side of the vertical position and release it, the force of gravity tends to pull it to a vertical position and to resist its going beyond that position, yet were the force ever so many times as great as it really is, it could never bring the pendulum to rest without the intervention of some extraneous force like friction or the resistance of the air.

If we have two masses in space connected by a spring capable of extension and compression, and if we displace these masses with respect to each other so that the spring is under stress, these masses if released will approach and recede from each other for ever if subjected to no other forces, the amplitude of the motion depending on the primary displacement, and the period on the relation between the spring force and the masses.

The action of the synchronising force between the alternators is analogous to the action of gravity on the pendulum, or to the action of the spring connecting two otherwise free masses as in the illustration cited above. The synchronising force tending to check the relative displacement between the generators exists only after the displacement has occurred; when the generators are in phase the force is nil, and consequently there is nothing to hold them there.

I believe I am saying something new when I make the assertion that in every practical case, the effect of the synchronising force of the alternators is to increase the irregularity of the angular speed of the engine instead of to diminish it.

On first consideration this proposition seems absurd, but nevertheless it is capable of being demonstrated practically as well as mathematically.

The matter first suggested itself to me some two years ago in connection with the paralleling of some alternators in which the synchronising power was rather large. The synchronising force in an alternator can be varied by increasing or decreasing the field current, and, in consequence, the voltage of the machine, and in these particular machines, which were of the two-phase type, the synchronising force could also be greatly reduced by running the machines with only one phase connected in circuit.

Some difficulty was experienced with the paralleling at the start, and a rather extensive line of experimental work was undertaken in the endeavour to locate the trouble and to overcome it. Having a tank load available, these experiments could be carried out independently of the demands of the regular lighting service, and consequently we were able to observe the action of the machines over any desired range of load and voltage. It was found that when the generators were run in single phase, they would parallel very satisfactorily, but when the second phase was cut in, the cross-current would increase, and quite serious transfers of energy would take place between the machines. At that time it was authoritatively denied by electrical engineers of high standing that any two-phase machine would ever parallel more readily on one phase than on both; now, however, I believe the fact is freely admitted.

It was also determined beyond question that by lowering the voltage to 80 per cent. of the normal—or, in other words, decreasing the synchronising force 20 per cent.—the action of the machines in parallel was not open to criticism, even when running with both phases connected up.

The repetition of these experiments a sufficient number of times to determine that the observed phenomena were not accidents, but were in accordance with some fixed law, made it quite apparent that, at least over the range covered by the experiments, the difficulties in paralleling increased with the synchronising force of the generators.

Irrespective of whether a correction of the trouble could be effected by decreasing the sensitiveness of the governor or improving the turning moment of the engine, or doing both simultaneously, the indisputable fact remains that with the original engine performance a variation of 20 per cent. in the synchronising power made the difference between success and failure in operating the generators in parallel, and this seems to indicate the utter fallacy of specifying the same characteristics in the engine for alternators in which the synchronising force may differ by 200 or 300 per cent.

The fact that the synchronising force does, under all ordinary conditions, increase the angular variation in the engine may be shown theoretically in a general way without recourse to any abstruse mathematics.

Fig. 1 represents a typical diagram of crank forces in a single crank double-acting engine. $A_1 B_1$ represents the path of the crank-pin for one revolution, and the ordinates of the curve represent to some chosen scale the tangential pressure on the crank-pin at the corresponding point in the revolution; the area included between the curve and the base line, $A_1 B_1$, represents the work per revolution in foot-pounds.

$A_1 C = B_1 D$ represents the mean resistance of a uniform load reduced to the radius of the crank, and neglecting friction the area of the parallelogram, $A_1 C B_1 D$, also represents the work per revolution in foot pounds.

The shaded portions of the area included between the lines C D and the curve if above the line C D, represent in length the portion of the revolution in which energy is being stored up in the fly-wheel, and in area, the amount of this energy in foot pounds. In like manner the shaded areas below the line, C D, represent the portion of the revolution in which the stored energy is being given up by the fly-wheel, and the amount of this energy.

While the crank is passing from E to G, the fly-wheel is absorbing energy and its velocity is increasing. Consequently at G, after having taken up the last foot pound of available energy, the velocity will have reached a maximum, and will then begin to decrease from G to I while the wheel is giving up energy, becoming a minimum at I; similarly other maximum and minimum points will be found at L and E. By mechanical integration of the curve in fig. 1 referred to the base line, C D, we obtain a second curve, fig. 2. The ordinates of this curve measured from the base line, $A_2 B_2$, representing uniform mean velocity, indicate the velocity of the crank-pin above and below the mean velocity. The scale of these ordinates depends on the mass and radius of the fly-wheel.

Referring to the velocity curve, fig. 2, it will be noted that the velocity is less than mean from A to F, and consequently at the end of this period, at the point F, the crank-pin will be at a maximum distance behind the position corresponding to uniform angular speed. From F to H the velocity is above the mean, and consequently at the point H the crank-pin will be a maximum distance ahead of the position corresponding to uniform angular speed, and so on.

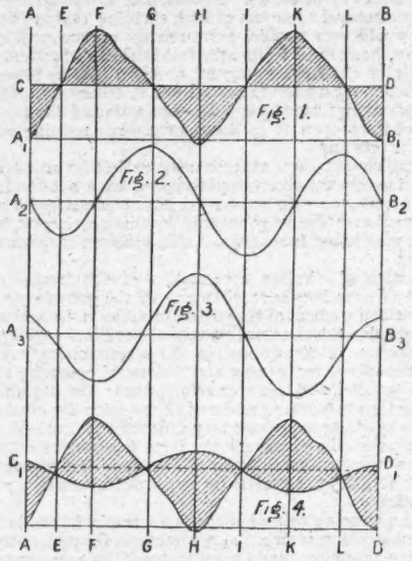
Integrating the velocity curve referred to the base line $A_2 B_2$, we therefore obtain a third curve, fig. 3, the ordinates of which referred to a base line $A_3 B_3$ drawn midway between the highest and lowest points in the curve, represent the departure at any point in the revolution from the position corresponding to absolutely uniform angular speed.

It will be noted that the displacement curve, fig. 3, and the curve of crank-pin forces, fig. 1, have a general resemblance in shape, in that each has the same number of nodes; but the nodes of one curve are directly opposite to those of the other. In other words, when the crank-pin effort is above the mean, and the surplus energy is accelerating the rotating masses, these masses are always behind the position corresponding to uniform angular speed, and when the crank-pin effort is below the mean and the rotating masses are being retarded, these masses are always in advance of the position corresponding to uniform angular speed.

Now let us consider the effect of the synchronising force of the generators. For simplicity we will assume that the engine-driven alternator is coupled in parallel with a number of turbine-driven alternators running at absolutely uniform speed, and that the total mass of these alternators is such that the synchronising force can effect no appreciable change in their velocity. Whenever the steam-driven alternator is behind the position corresponding to uniform angular speed, the synchronising force tends to accelerate the

* A paper read before the Engine-Builders' Association of the United States, at the annual meeting held in Pittsburg, Pa., May 22nd and 23rd, 1902.

rotating masses, and whenever it is in advance of the position corresponding to uniform angular speed, the synchronising force tends to retard the rotating masses. The intensity of these accelerating and retarding forces is represented at any point in the revolution by the ordinates of the displacement curve, the scale being proportional to the synchronising power of the generator. It will, therefore, be readily seen that the synchronising force acts in unison with the crank-pin force. During the period of the revolution in



which we have a surplus of crank-pin effort, this surplus is augmented by the synchronising force, and during the period in which there is a deficiency of crank effort, this deficiency is further augmented by the synchronising force.

This may be shown graphically in fig. 4, in which the crank effort curve is reproduced from fig. 1, and the line of load resistance, instead of being represented by a straight line, is represented by a curve of the same general form as the displacement curve, indicating the change in load during the revolution, due to the synchronising force. The shaded areas in this diagram illustrate the unbalanced forces resulting from the combination of the crank-pin and synchronising efforts. It will be noted that the unbalanced forces are very much greater than those due to crank-pin efforts alone, and as these unbalanced forces are the cause of the departure from the position corresponding to uniform angular speed, it is evident that whatever increases these unbalanced forces, will increase the variation from uniform speed.

The calculation of the exact amount by which the synchronising force increases the displacement is a tedious and somewhat involved mathematical process. It is necessary to compute the displacement from the force diagram, and after finding the value for the synchronising force, to construct a new diagram combining the two forces, and compute the displacement corresponding to the new force diagram. This process must be repeated until no appreciable increase in the displacement curve is found.

As stated previously, the effect of the sychronising force between the alternators is analogous to that of a spring capable of both extension and compression, and considered apart from all other forces, will produce an oscillation of the rotating masses, the period of which oscillation depends on the intensity of the sychronising force and the magnitude of the masses.

The period of this oscillation has a very important bearing on the amount the angular displacement is augmented by the synchronising force. With a period which I believe corresponds with the time of one revolution of the engine, the angular displacement seems to be increased indefinitely. As this natural period of oscillation is increased or decreased from the critical period, the effect of the synchronising force on the displacement seems to decrease.

Of course if the synchronising force were infinite, we would have the same effect as if the generators were solidly linked together, and the actual displacement would be the mean of the individual displacements of the several units in parallel, and would be less than that of any unit running independently. There is also perhaps a period of oscillation between the critical period, and an infinitely short period, which would not increase the displacement, and doubtless as the period decreased from this point, the displacement would decrease. I have, however, at the outset limited the general proposition to practical cases, and these are not practical. The rotating masses must of necessity be of such magnitude that it is impracticable to have a synchronising force sufficiently large to cause oscillations having a period much if any less than the time of one revolution.

I shall feel happy if I have succeeded in indicating a new line of investigation in connection with this troublesome problem, and shall be content to leave the investigation itself to those who are more able to carry it out to a finish.

I shall feel doubly happy if I shall succeed even in the smallest degree in making it plain to the electrical fraternity that the electrical and the dynamic features in the case are so inter-related that real knowledge can come only when the electrical engineer and the mechanical engineer drop all petty differences and co-operate with each other in the most frank and hearty manner.

As long as one is expected to blindly and unquestioningly follow the dictates of the other, successful paralleling will be by accident rather than design.

The whole matter is one of compromise. Let it be freely admitted that the irregularities in the action of the engine do set up electrical disturbances. The reciprocating engine will always have an irregularity in angular speed, and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by constructional and commercial limits from reaching absolute perfection.

On the other hand, the electrical disturbances react on the engine, augmenting the inherent irregularities in the latter, and the intensity of this reaction is within certain limits under the control of the electrical engineer.

It is therefore only when the engine builder and the electrical engineer each recognise the limits beyond which the other cannot go, and each endeavours honestly to make the task of the other as easy as possible, with due regard to the commercial excellence of the direct connected unit as a whole, that we may hope that the parallel operation of direct connected alternators will cease to be a subject for discussion.

Mr. G. Rosenburg, of Hanover, Germany, has written to the editors of *Electrical World and Engineer* (New York) on this subject as follows:—

"In some respects I have quite the same opinion as Mr. Longwell, and a paper referring to 'Paralleling of Alternators, especially if Driven by Large Gas Engines,' which I read before the Hanoverian Electro-technical Society on January 23rd of this year, contains some paragraphs and figures which are nearly the same as those of Mr. Longwell. I will add that it is impossible that Mr. Longwell had knowledge of my paper, for it was published in three parts, not earlier than the month of May, the 15th, 22nd, and 29th. *(Elektrotechnische Zeitschrift)* But I am happy that Mr. Longwell comes to the same result as an electrical engineer handicapped by a 'formidable array of mathematics, Greek letters, and scientific terms.'

"I concede to Mr. Longwell that it is quite possible to understand without mathematics that the synchronising force increases the angular variation in an engine. I showed the same with figures similar to those of Mr. Longwell, both with theoretical sinoidal diagrams of crank forces and with practical diagrams of steam and gas engines. But if one uses only these diagrams, the calculation of the total amount by which the synchronising force increases the displacement is indeed, to use Mr. Longwell's words, 'a tedious and somewhat involved process.' But with a little 'array of mathematics,' and with a polar diagram of oscillating and damping, I was able to show that the total increase of the degree of irregularity, also the increase of the oscillating velocity and variation, and the resulting increase of the synchronising force is:—

$$\frac{1}{1-q}$$

where q is the proportion between the first synchronising force and the oscillating force of the original crank-force diagram. If, in Mr. Longwell's fig. 4, the curve, C D, of the first synchronising force is in a proportion

$$\frac{1}{10}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2}, \ldots,$$

to the original oscillating force of the curve, A B, the total increase of irregularity, &c., is

$$\frac{10}{9}, \frac{5}{4}, \frac{3}{2}, \frac{2}{1}, \ldots.$$

Therefore I concede to Mr. Longwell that one must not ask the same angular displacement for alternators with different short-circuit currents. But one must also not ask the same variation from engines with different crank-force diagrams. A double steam engine must not have so great a variation as is allowed for a single steam engine, and the latter must not have the same as a two-cycle gas engine. A variation of 3 or 4 electrical degrees, which does not matter in a gas-driven alternator with a very great oscillating force in the crank-force diagram, and with a heavy fly-wheel, may give enormous trouble in an alternator driven by a twin steam engine with very low oscillating forces in the original diagram and with a light fly-wheel."

Dewsbury.—An inquiry was conducted on Thursday last week by Mr. R. H. Bicknell, inspector of the L.G.B., into an application of the Corporation for sanction to borrow £10,000 for the extension of the electricity works. There was no opposition. It was stated that the total sum borrowed for electric lighting purposes was £41,420. The £10,000 asked for was not strictly for lighting purposes, but for the extension of the works to supply energy to the British Electric Traction Company, who had agreed to take energy for running their electric cars. This involved the provision of extra plant equivalent to 300 KW. capacity.

ON SOME PHENOMENA AFFECTING THE TRANSMISSION OF ELECTRIC WAVES OVER THE SURFACE OF THE SEA AND EARTH.

By Captain H. B. JACKSON, R.N., F.R.S. Paper read before the Royal Society, May 15th, 1902.

(*Concluded from page* 299.)

The next cause that I shall consider is that due to the varying conditions of the atmosphere; some of these conditions constitute a most serious obstacle to the effective transmission of electric waves over medium distances, and are, in consequence, a source of error likely to be encountered, and which cannot be foretold nor allowed for in wireless telegraphy.

As far as my experiences go, these effects are much less frequently noticed in temperate than in sub-tropical regions. In the Mediterranean Basin they seem to be particularly prevalent, and most persistent in summer and autumn.

Owing to their sudden advent, and their equally sudden cessation, it is most difficult to carry out systematic or pre-arranged experiments, and I must therefore confine my remarks to general observations as to their effects in various parts of the Mediterranean Sea.

The first case is that due to the effects of lightning discharges, which may or may not be visible at the station where its effects are noticed. As a rule, with the instruments in normal adjustment, the effect of every discharge is to record a signal, the exceptions being very few.

The method adopted to observe this was to fit an electrical bell, worked by the receiving instruments, close to the observer, and at night observe the flashes and note if the bell rang.

For detailed observations, it was found more convenient to record the effects on the tape, and this was the method subsequently adopted. On the approach of the area of disturbance towards the ship, the first visible indication generally is—the recording of dots at intervals varying from a few minutes to a few seconds; secondly, the recording of three dots with a space between the first two, thus: (· ··) or *e i*, in the Morse code, and this is the sign most frequently recorded by distant lightning; thirdly, the recording of dashes; the intervals between these then gradually decrease and merge into irregular signs, which have sometimes spelt words in the Morse code; the effects generally die out more suddenly than they appear.

They are much more frequent in summer and autumn than in winter and spring—in the neighbourhood of high mountains than in the open sea—in southerly than in northerly winds (in the Mediterranean Sea)—in the front of a cyclonic disturbance of the atmosphere than in the rear, and with a falling barometer than with a rising one. In settled fine weather, if present, they reach their maxima between 8 and 10 p.m., and frequently last during the whole night, with a minimum of disturbance between 9 a.m. and 1 p.m.

The next cause, which is intimately connected with the above, is the shorter distance at which signals can usually be received, when any electrical disturbances are present in the atmosphere, compared to the distance at which they can be received when none are present. The distance varies from about 30 to 80 per cent. compared with that obtained in fine clear weather. It does not in any way decrease with the increase of the number of lightning discharges which register their effect on the instruments, at any given time, but rather the reverse, the loss in distance generally preceding the first indications, on the instruments, of the approaching electrical disturbance.

A very marked case is given as an example: Two ships whose instruments were in perfect order, and whose sea-signalling distance was about 65 miles, opened their distance from each other on a fine, calm, bright day; when they were 22 miles apart, the signals died away, though there was no intervening land or other apparent cause for this, but it was noticed that the barometer was falling; the ships closed, and got into communication again. Atmospheric disturbances were then registered on both sets of instruments, and on the ships opening out again, no signals were obtained over 20 miles. The trials were concluded shortly after, owing to intervening land. A few hours later a heavy winter gale came on, and its approach had evidently been foretold by the falling barometer, the loss of distance in signalling, and the electrical disturbances in the atmosphere, as shown by the signals received on the instruments. No lightning flashes were observed.

On another occasion, during a period of strong but intermittent atmospheric effects, no signals were obtainable between two ships up to the usual maximum signal distance. When separated 50 per cent. beyond this distance, and immediately after a particularly strong and persistent series of electrical discharges, the latter half of a signal which was being transmitted very slowly was correctly deciphered at a distance then considered phenomenal, with the instruments employed at the time. A few minutes later, the atmospheric effects vanished, and with them all signs of further signals, till the ships had closed to their usual signalling distance. This demonstrates that the actual electrical discharges do not of themselves reduce the signalling distance or transmission of the waves at all times, but that they may, under some circumstances, assist that transmission, possibly by a cumulative effect of the waves emitted by the discharges on the waves emitted by the transmitter, these combining and increasing the effect in the receiver. I have recorded similar results, which I cannot attribute to any other cause.

Another effect which reduces the usual signalling distance, is one that I attribute to the presence of material particles held in suspension by the water spherules in a moist atmosphere.

The Mediterranean Sea is, for days together, frequently exposed to the force of the scirocco wind; this south-easterly wind is laden with damp, and often charged with salt from spray, and dust particles from the African coast. During the continuance of these winds, the maximum signal distance is generally less than in winds (wet or dry) from any other quarter, the proportional distance being from about 60 to 80 per cent. The effect of a scirocco wind can be and is allowed for in practical wireless telegraphy.

The causes that I have considered above, and which all tend to lessen the maximum signalling distance that would obtain under more favourable circumstances, may all be attributed to influences which are beyond the control of the designers or operators of the instruments used in wireless telegraphy.

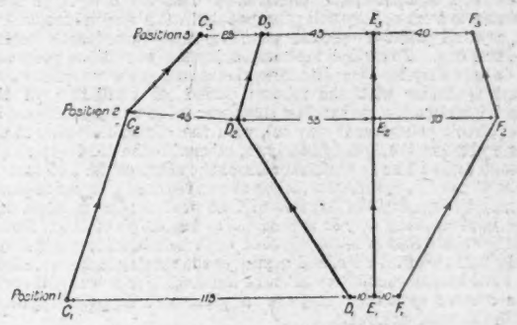


Diagram of Ships' Courses.

I have now, however, to consider a phenomenon which I can only assign to the apparatus in which the waves of electrical induction are generated. This phenomenon manifests itself by the gradual weakening and occasionally by the total cessation of signals, as the distance between the two ships increases, up to a certain point, and their reappearance as the distance is still further increased; in the majority of cases, the weakening of signals occurs at, or about, half the signalling distance in the open sea, under the same circumstances, which circumstances include the direct connection of the aerial wire to one ball of the induction coil used for transmission.

The three following examples are typical cases. Units of distance are given in lieu of nautical miles.

(*a*) A ship, A, steamed away from a station, B, to ascertain the maximum distance at which she could receive signals in the open sea.

At 48 units of distance, the signals weakened, at 57 they ceased, at 65 they appeared again, and were kept up to 100 units of distance.

(*b*) Four ships, C, D, E, F, steered as shown in the diagram, the maximum signalling distance between each pair being about 100 units of distance.

(The results of the signals transmitted by D are those specially to be considered.)

In position (1) D's signals were received by E F, not by C.

" (2) " " " F, " E C.

" (3) " " " C F, " E.

C did not commence signalling before reaching (2), and her signals were received by D and E, and maintained by them to position (3), when the trial was finished.

E's signals, which were few in number, were received by C and D in (3), but not by D in (2).

(*c*) In the third example, ships D and F carried out a similar trial independently. Between 45 and 55 similar units of distance no signals could be exchanged either way, though at 60 units and above, and below 40, the signalling was perfect.

To further verify that it was the system of transmission that was the cause of this cessation of signals, a syntonic method, of the same approximate frequency of transmission, though of rather less power, was used alternately with the other system. Signals were exchanged perfectly with the syntonic method, but on reverting to the other method, the signals again ceased.

This was tried repeatedly with identical results. Many other similar cases have been recorded, but the effects are not always so equally well marked, even under identical circumstances.

I consider this effect is due to want of synchronism in the oscillatory discharge between the spark balls of the transmitter. This want of synchronism has also been observed by others in the photographs of oscillatory spark discharges. C. Tissot* especially remarks that, in his apparatus (presumably used for a wireless telegraph transmitter), the images of the successive sparks are not

* *Comptes Rendus*, Vol. 132, p. 763, March 25th, 1901; and Vol. 133, p. 929, December 2nd, 1901.

equidistant, and that the first interval is always greater than the other intervals, which also decrease very slightly. This implies that the first wave emitted is longer than the second, and so on. Owing to the rapid damping of our form of transmitter, probably only the first two or three waves emitted are of any practical value in exciting the coherer in wireless telegraphy at a distance of 30 miles; and to excite it at such distances with the power used in these transmitters, it is probably essential that the effects of the successive waves should be cumulative in their action, and for them to be so they must syntonise with the natural period of oscillation of the receiving circuit, which period, in the cases under notice, was the mean frequency of the waves emitted by the transmitter as nearly as this could be practically adjusted.

Consider the first two waves emitted, or the interval between the first and fifth sparks of the oscillatory discharge, when the third one is not spaced midway between them; the resulting waves, differing but little in length, and moving with equal velocities, and in the same direction, leave a point O (the spark gap), the second starting a mean wave-length behind the first one, and in the same phase; at some fixed point, P, in their path, owing to the difference in their length, the two waves will pass that point in the opposite phase, and at a point, Q, approximately double the distance from O that P is from O, they will pass Q again in the same phase, and so on, as at all points the second wave is a mean wave-length behind the first one. *To excite the coherer*, under the conditions presumed to be necessary for long distances, the impulses due to these waves must syntonise with the natural period of oscillation of the receiving circuit, and therefore these successive waves must pass by that circuit (wherever it may be), with the second following in the same phase as the first, or nearly so, otherwise the tendency of the second one will be to weaken or annul the effect of the first one.

At the point, P, therefore, when the waves are in opposite phase, it may be expected that signals will be weak, and at Q, when they are in phase, they *may be* strong, but owing to Q's distance from O being double that of P, the effect of each individual impulse at Q is only half its effect at P, and Q *may be* the maximum distance from O, at which the cumulative effect of the successive waves will excite the coherer, even when they are in phase and in perfect syntony with the receiver circuit.

I have not yet been able to investigate the exact cause of the non-synchronous emission of the waves, but I attribute these "zones of weak signals" (as I term them) to this non-synchronous emission of the waves, and to the rapid damping of this form of transmitter, and would observe that when using my syntonic transmitter, in which the damping is less rapid, I have never noticed these effects.

A point of interest, which has also great effect on the signalling distance, is the efficiency of the earth connection of both the transmitting and receiving instruments. Fortunately for the system, on board a modern ship there is no difficulty in obtaining an almost perfect earth connection when the ship is at sea. In dry dock, however, there is, in fine weather, a great difficulty in doing so, and the effects of the bad earth with the ship in dock, on the signals, are extremely marked, both for transmitting and receiving, reducing the distance as low as to 25 per cent. of the distance with the ship afloat.

A similar effect, due to drought, has been observed with some shore stations, where, according to my experiences, the maximum signalling distances have always been obtained during wet seasons of the year.

A typical example is given:—

On one particular occasion, towards the end of a very dry summer (last year), the maximum signal distance between a certain ship and station, 500 ft. above the sea, was 38 miles, the usual distance having previously been 68 miles. Two days later, during which time no alterations whatever had been made to the adjustments of the instruments, but which included 24 hours of heavy rain, the maximum distance obtained was 70 miles, which has since been maintained.

Repeated experiments with and without earths on the transmitter and receiver have shown me that, in the open sea, signals may be obtained up to 50 or 60 per cent. of the full distance, without earths on the receiver, though such a large proportion is unusual, the average being 30 per cent. A condenser of suitable capacity acts nearly as well as a good earth; without an earth on the transmitter, the percentage of distance has never exceeded 15 per cent. Using good earths, but no aerial wire whatever on the receiver, or near it, signals have never been obtained over 3 miles. With no aerial wire on the transmitter, I have never known a signal to be received on board another ship over 2 miles distant.

My experience demonstrates most clearly, and with no marked exception, that, for signalling any distance beyond a few miles, the combination of aerial wires and good earths is essential, for both transmitting and receiving instruments.

Summary.

The results of my observations may be briefly summed up as follows:—

1. That intervening land of any kind reduces the practical signalling distance between two ships or stations, compared with the distance obtainable in the open sea, and that this loss in distance varies with the height, thickness, contour, and nature of the land; and that, based on the results of these observations, it may be concluded that some of the waves of electric induction, transmitted by wireless telegraphy, may pass through, over, and possibly round the land, and are comparable to the passage of ocean waves through or over a reef, or round high land, which waves proceed along their course with diminished energy, after passing such obstructions.

2. That material particles, such as dust and salt held in suspension in a moist atmosphere, also reduce the signalling distance, probably dissipating and absorbing the waves.

3. That electrical disturbance in the atmosphere also acts most adversely to the regular transmission of these waves, in addition to affecting the receiving instruments by lightning discharges.

4. That a system of transmission in which the oscillations are rapidly damped is irregular in its action on distant receivers, owing to the irregularity of the train of waves giving rise to different types of disturbance at different parts of their path, which may not have at certain points the necessary cumulative effect on the receiving circuit.

5. That the earth's function in the transmission of waves is most important; but that its importance is secondary to that of the aerial wire or capacity insulated in the air above the surface of the surrounding sea or earth.

I have to thank many of my brother officers and men in H.M.'s Navy for the valuable assistance they have ungrudgingly given me in carrying out my experiments.

THE IDEAL ELECTRICAL ENGINEERING COURSE.*

By CHARLES P. STEINMETZ.

With to-day's meeting ends the first Institute year in the new century, and it may be appropriate then to look back into the work achieved and forward into the future.

At the entrance of the nineteenth century we see empirical science struggling for recognition against metaphysical speculation. At the entrance of the twentieth century metaphysics has practically ceased to be considered, and empirical science is universally acknowledged as the source of all human progress. In gradual advance from success to success this victory has been won. Without any restraint empirical science can now expand. But with the removal of the opposition of a hostile philosophy, has been removed also the searching criticism into the correctness of the results, the methods and the theories propounded by empirical science, and thereby the absolute safety which characterised the work of the earlier period. Herein lies the greatest danger to the unbroken progress of science.

Facts, whether incidently observed, or intentionally, by experiment, are the foundation of science. But the mass of facts has accumulated so as to be beyond comprehension and we are forced thereby to work with the conclusions from the facts, the empirical rule, theory, hypothesis, and have become so used thereto that gradually the dividing line between the theory and the underlying facts has become blurred, and we consider the theory and attribute to it the same certainty as only the facts have on which it is based. But, however well a theory represents the facts and proves its value in successful application, it unavoidably contains besides the facts on which it is founded, foreign elements, mainly the personal equation of its originator and the personal equation of its times. And when building upon theories, the danger exists that instead of upon the facts represented by the theory, we may build upon the personal equation of the time without realising the unsafe foundation of our structure.

The reverence for the facts as the foundation of science has been extended to the theories based thereon. But, when by building theories upon theories, conclusions are derived which cease to be intelligible, it appears time to search into the foundations of the structure and to investigate how far facts really warrant the conclusions. If we are told of matter moving in a vacuum tube with velocity comparable with that of light, of small chips breaking off atoms, of free atoms of chlorine and sodium floating around in a salt solution charged with opposite electric charges, whatever that may be, of electricity being propagated not through the conductor, as we used to assume, but through the space surrounding it, &c, it is time to pause and try to understand.

In the gradual replacement of facts by the belief in theories, more or less inadequately representing the facts, lies the chief danger to further scientific progress. Here is a field where splendid work can be done and should be done, in destructive criticism, by the younger generation, which, after leaving college with all the theoretical armament required, is not yet handicapped by personal relations with the men whose names are identified with the ruling theories.

Especially for our branch of electrical engineering, this is of fundamental importance, since all the success of our work depends upon the absolute safety of the foundations on which we build.

All future progress in science and engineering depends upon the young generation, and to ensure an unbroken advance it is of pre-eminent importance that the coming generation enters the field properly fitted out for the work.

Here the outlook appears to me by no means entirely encouraging.

It is not the object of the college or university to turn out full-fledged engineers who can handle any engineering problem of any magnitude. The available time is altogether too short, and a very great deal of practical experience is required, which is not available to the educational institution. It is not necessary, either, and the college graduate is not expected to take immediate charge of engineering works of great magnitude. All the educational

* Presidential address before the American Institute of Electrical Engineers at Great Barrington, Mass., June 21st, 1902.

institution can do and should do is to fit the student so to take up the practical work as efficiently as possible, and that is to give him a thorough understanding of the fundamental principles of electrical engineering and allied sciences, and a good knowledge of the methods of dealing with engineering problems.

The average college course at present does not do this.

One of the reasons of the inefficiency of the present college course is the competition between colleges. By trying to teach more than other colleges, gradually the quantity of material taught by our colleges has increased so that it is not possible any more to give a thorough understanding, and memorising takes the place of understanding. Memorising, however, is an entirely useless waste of energy, since anything that is not perfectly understood, but merely memorised, will be forgotten in a short time if not continuously applied, and if continuously applied it would be remembered anyway. If, of the amount of material in electrical engineering as well as other branches which the educational institution of to-day attempts to teach, one-half or more could be dropped altogether, but the rest taught so as to be fully understood, with special reference to general principles and methods, the product of the institution would be far superior and more successful in practical life. To be dropped, then, are all formulæ, rules, &c., beyond the most simple ones, of the scope of the multiplication table, &c. When needed, formulæ can be derived from the fundamental principles, or looked up in the literature, and their memorising is a mere waste of valuable time, useless, since the memory cannot retain them if the understanding cannot reproduce them from their premises. This, for instance, applies to the various formulæ of electro-magnetic induction, the equations of the transformer and other apparatus, and theoretical investigations in general.

Still more than in electrical engineering this applies to the allied branches of science and engineering, of which the electrical engineer should have a fair understanding. Here anything beyond fundamental principles is objectionable. The electrical engineer should understand the principle of the steam engine, of the hydraulic turbine, know why the spouting velocity and the peripheral speed of the water-wheel are related to each other theoretically, and how this relation is modified actually, but should not memorize the mathematical theory of the turbine with its half-dozen unknown friction coefficients. He is not expected to design turbines, and if he did, his design would surely be a failure, but he is expected to understand the turbine, the steam engine, &c. The engineering graduate should know the principles of the strength of materials, the distribution of forces in the loaded beam, the reasons leading to the I-beam, to the triangle in bridge and roof construction, but time should not be wasted in calculating bridges or deducing elastic curves, &c.

In short, in electrical engineering, and more still in all allied branches, nothing beyond the general principles is needed for success, but the principles should be fully understood, and with the limited time at disposition this cannot be done if time is wasted in memorising things to be forgotten afterward.

One of the objectionable features of the instruction of most colleges is the step-by-step method. One subject is taken up, by application of sufficient time and energy pushed through, and then, after passing an examination, dropped to take up another subject.

It is true that by steady application to one subject a great deal can be learned, and so splendid results derived in the examination papers: but all that is learned in this manner is forgotten just as rapidly. To understand a matter thoroughly, so as really to have a lasting benefit therefrom, and not only make a good showing in examination papers, requires several years' familiarity therewith. Any subject, therefore, that is not kept up during the whole college course might just as well be dropped altogether and the time spent therein saved.

We hear that college graduates have no mastery of the language, cannot express themselves logically, and therefore recommend that more time should be devoted to literature and instruction in the English language. But as long as we do not teach logic, but have English language taught by philologists, more or less of the character of the florid newspaper style, that is, to write very many words on a very small subject, no useful results can be expected. Logic should be taught by a scientist, and the principle of English teaching to engineers should be to enable them to explain a subject intelligently and logically, with as few words as possible. That is, Faraday's researches, and not the product of the successful novel writer, should be the example aimed at.

The combination of text-book and home work offers a splendid means for incompetent instructors to make an elegant showing in the examination papers, and turn out a very inferior grade of men—men who sometimes do not even know what real understanding means. Free lectures on subjects which the instructor himself thoroughly understands—which is by no means always the case now—make it possible to direct the course so that the student's understanding follows the course, and in this case home work becomes superfluous, excepting in connection with the laboratory. Reviewing the lectures and filling out the gaps due to absence, &c., appears to me the only legitimate requirement on the student's time outside of the lecture room.

The present method of examination, which consists in expecting the student to answer ten questions or so within a few hours, is faulty. It shows what the student has memorised, but not how far he understands it. Furthermore, the brilliant student who usually answers nine out of ten questions correctly, and would have answered the last if he had not made a slight mistake, displaced a decimal point or so, in practical life may be utterly useless, since while doing very rapid work, his work is not reliable; while a slow man, who, however, can absolutely rely on the correctness of his work, will be very successful in practice, while hardly passing the college examination.

What, then, should an ideal electrical engineering course contain?

Of mathematics, plane and some solid geometry, arithmetic, and a good knowledge of algebra. Plane trigonometry—no spherical trigonometry required—and a thorough understanding of analytical geometry and of calculus, but no memorising of integral formulæ, &c.; they can always be looked up in a book when needed.

A thorough knowledge of general physics, especially of the law of conservation of energy, which, I am sorry to say, is not yet an integral part of our thinking, and of chemistry, especially theoretical chemistry and chemical laboratory, in the latter freely using tables, &c.

The electrical laboratory work should be taken up right in the beginning. Even before taking up the theory of apparatus, the theoretical investigation of alternating currents, self-induction, transformers, &c., the student should have met this phenomenon and handled the apparatus in the laboratory. Only after seeing the effects of self-induction, for instance, on the alternating-current circuit in the laboratory, will the theory of self-induction have any meaning and make an impression on the student. What the student has seen practically in the laboratory he will then take up in the theoretical course, to understand it, learn to calculate and control, and afterward, going back once more to the laboratory, apply it. It is here where the average college graduate is inferior to the practical man, and in spite of his handicap regarding theoretical knowledge, the latter frequently pushes ahead of the college graduate by his superior understanding of the phenomena, based on his familiarity with them.

Design of electrical apparatus is of very secondary utility and rather objectionable, with the exception perhaps of some very simple apparatus. The considerations on which designs are based in the engineering departments of the manufacturing companies, and especially the very great extent to which judgment enters into the work of the designing engineer, makes the successful teaching of designing impossible to the college. Far better is the reverse operation, the analytical investigation of existing apparatus, and more instructive to the student. That is, to derive from existing first-class apparatus by measurement and test the constants of the apparatus, and to calculate these constants and compare them with tests. Besides, a very small percentage of the college graduates enter the field of designing, but most of them will have to handle apparatus, and it is therefore very much more important to be familiar with the completed apparatus in all its characteristic features, in normal and in abnormal operation, than to be able to design it.

The proceeding naturally can be a short outline only of the work which I consider appropriate to an electrical engineering course, but I believe the general principles of the course can herefrom be understood. They are to give the student all the groundwork required to be successful in future practice, but have not the impossible aim of giving him a complete education as practical engineer.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

17,534. "Improvements in electric locomotives." B. Hopkinson. August 11th.

17,538. "Automatic guard for electric trams." W. Jones and J. H. Howell. August 11th.

17,587. "Improvements in and relating to electrolytic incandescent bodies particularly applicable to Nernst lamps." H. Bauer. July 11th.

17,589. "A movable electric contact for switches and other electrical connections." Sir H. E. Colville. August 11th.

17,611. "Improvements in electric clocks." C. J. Mobero. August 11th. (Complete.)

17,624. "Improvements in and relating to wireless telegraphy." L. H. Walter and J. A. Ewing. August 11th.

17,633. "Improvements in the method of and means for securing shades, reflectors, or the like, used in connection with incandescent electric lamps." A. Morrison and J. W. Butterworth. August 12th.

17,667. "A new or improved maximum demand indicator for alternating electric currents." C. J. Evans. August 12th.

17,675. "An improved stopping device for electric motor vehicles." R. B. Beattie. August 12th.

17,678. "Improvements in or relating to electric lamp globes." R. Bohm and E. Bohm. August 14th.

17,685. "Improvements in electrical motor counters." O. T. Blathy. August 12. (Complete.)

17,687. "Improvements in maximum demand electrical indicators." H. H. Lake. August 12th.

17,688. "Improvements in commutator brushes." H. H. Lake. August 12th.

17,689. "Improvements in or relating to electric arc lamps." H. H. Lake. August 12th.

17,690. "Improvements in electric arc lamps." H. H. Lake. August 12th.

17,691. "Improvements relating to armature windings for induction motors." H. H. Lake. August 12th.

17,703. "Signalling by electro-magnetic waves." R. A. Fessenden. August 12th. (Complete.)

17,704. "Improvements in wireless signalling." R. A. Fessenden. August 12th. (Complete.)

17,705. "Improvements in wireless signalling." R. A. Fessenden. August 13th. (Complete.)

17,706. "Improvements in wireless signalling." R. A. Fessenden. August 12th. (Complete.)

17,707. "Improvements in transmitting and receiving signals." R. A. Fessenden. August 12th. (Complete.)

17,708. "Improvements in signalling by electro-magnetic waves." R. A. FESSENDEN. August 12th. (Complete.)

17,712. "Improvements in hot wire electric meters." R. S. STEWART. August 12th. (Complete.)

17,757. "Electric automatic switches." R. C. HARPUR and A. A. WHITLOCK. August 13th.

17,762. "The automatic catch-point trolley for use on electric cars working on overhead wires." J. REYNOLDS. August 13th.

17,794. "Improvements in apparatus for actuating the electrical controlling appliances of the motors of electric railway cars." SIEMENS BROS. & COMPANY, LIMITED. August 13th.

17,811. "Improvements in insulating apparatus for electric currents of high tension." K. S. LEMSTROM. August 13th. (Complete.)

17,812. "Improvements in receiving and recording apparatus for wireless telegraphy." M. L. SOLARI. August 13th.

17,841. "Improvements in methods of and means for producing and shaping electric current pulses." F. H. LORING. August 14th.

17,867. "Moisture and water-proof fixture and guard for electrical attachments, such as incandescent lamps, plug attachments and the like." A. F. HAUSS. August 14th. (Complete.)

17,885. "Method and apparatus for producing currents of high frequency." R. SCHARP. August 14th.

17,886. "Improvements relating to electric arc lamps." H. BREMER. August 14th.

17,902. "Improvements in apparatus for curative treatment by aid of electricity and oxygen." J. J. STANGER. August 14th.

17,913. "An improvement in arc lamps." F. J. GREEN. August 14th. (Complete.)

17,923. "Electric arc lamp." J. A. RIGNON. August 14th. (Complete.)

17,924. "An improved electric igniting candle for explosion motors." H. LUTHY. August 14th. (Complete.)

17,927. "Improvements in electricity meters." G. C. FRICKER and W. M. MORDEY. August 14th.

17,952. "Improvements in and connected with electricity meters." B. NORTH. August 15th.

17,953. "Improvements in marine electric light fixtures." G. L. MARTIN. August 15th. (Complete.)

17,994. "Improvements in electric interrupters." L. G. NILSON. August 15th. (Complete.)

17,995. "Improvements in driving mechanism for electric road vehicles." L. G. NILSON. August 15th. (Date applied for under Patents Act, 1901, May 15th, 1902, being date of application in U.S.A.) (Complete.)

17,997. "Improvements in controllers for electric motors." L. G. NILSON. August 15th. (Date applied for under Patents Act, 1901, May 15th, 1902, being date of application in U.S.A.) (Complete.)

17,998. "Improvements in electric-gasoline vehicles." L. G. NILSON. August 15th. (Date applied for under Patents Act, 1901, May 15th, 1902, being date of application in U.S.A.) (Complete.)

18,009. "Improvements in devices for electric ignition of flammable gases." E. H. PRYCE. August 15th.

18,021. "Improved adjustable electric switches or circuit breakers." F. D. EMERY and A. J. HALLAM. August 16th.

18,055. "Continuous action electric bell." B. BRANDER. August 16th.

18,076. "Improvements in systems of electrical distribution." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,077. "Improvements in electric current collectors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,078. "Improvements in current limiting switches for electric lights." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,079. "Improvements in protective devices for electric circuits." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,080. "Improvements in electric current regulators." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,082. "Improvements in charging devices for storage batteries." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,084. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,086. "Improvements in charging devices for electromobiles." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,088. "Improvements in electric transformers." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,089. "Improvements in magnetic separators." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

18,090. "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. August 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 2d. (in stamps).

1900.

11,915. "Improvements in and in connection with trolleys for electric railways or tramways." C. P. Tomb. Dated July 2nd, 1900. Relates to electric railways and tramways with overhead conductors. Collectors.—To lower the trolley pole automatically in case it escapes from the conductor, the rack which gears with the end of the pole is connected to a piston working in a cylinder to which air under pressure is supplied when the current is broken. The air supply and exhaust is controlled by a three-way valve, which is turned to supply air by a spring when the electro-magnet liberates a catch from the valve spindle. The cylinder is mounted on the swivelling base of the trolley pole, and the piston rod and rack are connected to a crosshead which is drawn back by springs on the side bars of the frame. 9 claims.

11,933. "Improvements relating to the regulation of electric motors." R. Lundell. Dated July 2nd, 1900. In order to obtain a great variety of speeds and minimise sparking in series-parallel motors, the field magnets are energised by a small regulable motor-generator, or from some other source of variable electromotive force. 6 claims.

11,937. "Improvements in telephone systems." F. B. Stafsing and C. Egner. Dated July 2nd, 1900. Relates to arrangements by which subscribers in communication are warned that an operator is listening. 3 claims.

11,941. "Improvements in regulating appliances in connection with electric motors for turret turning, gun training, and analogous purposes." W. H. Scott. Dated July 2nd, 1900. Relates to means for controlling the speed of electromotors used for gun training, turret turning, and for other purposes where a very wide range of speed is required. The regulation of a shunt motor from maximum to two-thirds speed is obtained by varying the shunt excitation in the usual way, but to reduce still further the speed, resistance is placed in the armature circuit, while the current is maintained approximately constant by automatically applying a brake to the motor when a reduction in the current strength takes place. The current being constant, the pressure at the motor brushes (and therefore also the speed) is completely under control. 1 claim.

11,944. "Switching arrangement for Nernst and vacuum incandescence lamps." V. F. Fossy. (Allgemeine Electricitats Gesellschaft.) Dated July 2nd, 1900. Relates to systems of lighting with lamps of the Nernst type, in which an ordinary incandescent lamp is first switched in, and afterwards cut out automatically or by hand when the Nernst lamp or lamps are glowing. 4 claims.

11,991. "Improvements in rheostats for electric motors." British Thomson-Houston Company. (J. L. Hall, U.S.A.) Dated July 3rd, 1900. Relates to resistance switches or rheostats for electric motors of large horse-power. To prevent arcing at the rheostat contacts when the drum is automatically returned to its initial position, the arrangement is such that a short-circuit round the rheostat is closed after the motor is started up; this short circuit is automatically broken upon overload or other abnormal circuit conditions arising. 7 claims.

12,003. "Improvements relating to dynamo-electric mine exploders or apparatus for firing explosives." J. Wetter. (L. C. Goniant, France.) Dated July 3rd, 1900. A dynamo-electric machine for igniting explosive charges is provided with means for automatically closing the external circuit when the dynamo attains its maximum power, and with means for testing either the internal or the external circuit. 5 claims.

12,009. "Improvements in and relating to apparatus for receiving and recording messages." H. H. Lake. (R. W. Gordon, U.S.A.) Dated July 3rd, 1900. Relates to improvements in that class of apparatus described in Specification No. 14,547, A.D. 1899, a number of the call circuits being brought to a multiple receiving apparatus so that their individual signals are registered on one tape together with the time of receipt of each signal. 11 claims.

12,016. "Improvements relating to electrically-propelled motor road vehicles." T. J. Ryan. Dated July 3rd, 1900. Relates to controlling means for electrically-propelled vehicles, and comprises combined current-controlling and reversing switches, in which a single handle common to both is adapted to operate each independently, while the reversing switch can be operated only when the motor-circuit is open. 7 claims.

12,017. "Improvements relating to motor road vehicles." T. J. Ryan. Dated July 3rd, 1900. Relates to means for controlling electrically-propelled vehicles, and comprises combined steering mechanism and current-controlling and reversing switches, with or without a brake switch, capable of being independently operated by one hand; also a safety appliance for interrupting the motive current when the vehicle seat is not occupied. 6 claims.

12,018. "Improvements relating to electric propulsion for motor road vehicles." T. J. Ryan. Dated July 3rd, 1900. Relates to means for controlling electrically-propelled vehicles, and comprises a current-controlling switch and a reversing switch, both capable of being operated independently by movements of the same pedal in different planes. 3 claims.

12,074. "Improvements in static voltmeters." Siemens Bros. & Co. (Siemens and Halske.) Dated July 4th, 1900. In any electrostatic voltmeter the charged surfaces are arranged so that when they move towards one another, air is compressed between them to damp the movements. In one form an aluminium body of circular or other section is carried by wires on a axle, which also carries a pointer and a balance weight, and is controlled and connected electrically by a spring; the body is attracted into, and nearly fits, a stationary curved box of insulating material, with a thin coating of metal, which is the second charged surface. The body may be opened at the end which enters the box. 2 claims.

12,112. "Improvements in and connected with block signalling apparatus for railways." F. Krezch. Dated July 4th, 1900. Semaphore, &c., signals, controlling and locking signals, inter-locking, signalling instruments, signalling, &c., between trains, indicators and repeaters signal, contacts electric. Relates to electrical apparatus for operating and controlling the operation of railway signals on the block system. 23 claims.

12,152. "Method of increasing the capacity of lead secondary batteries in practical use." C. Keim. Dated July 5th, 1900. The capacity of secondary batteries is increased by heating them while charging or discharging or during both these operations. The invention is particularly applicable for increasing the capacity of batteries which are used in combination with dynamos in systems of electric traction for taking up large variations in the current. Reference is made to Specification No. 1,484, A.D. 1892. 3 claims.

12,166. "Improvements in the manufacture of filaments for electric incandescent lamps." V. Thomas. Dated July 5th, 1900. Incandescent lamp filaments are made of graphite or carbon and a refractory oxide from a mixture containing 15 parts of nitro-cellulose dissolved in 85 of glacial acetic acid, and either 2 per cent. of cerum acetate, or 2 per cent. of thorium or beryllium acetates. These salts must be pure and are added in aqueous solution. Nitrates may be used instead of acetates. 5 claims.

12,170. "Electric Meters." P. Mandowsky. Dated July 5th, 1900. Relates to quantity meters. 1 claim.

12,175. "Improvements in controlling apparatus for electric circuits." Thomson-Davies Telephone System and A. T. M. Thompson. Dated July 5th, 1900. Relates to arrangements in electric signalling systems, especially in automatic call telephone systems, by which the called subscriber's bell is rung for a predetermined interval of time. 6 claims.

12,179. "Improvements in and connected with electrical tramways or railways." H. Hirst. Dated July 5th, 1900. Electric railways and tramways are arranged so that if vehicles are running in opposite directions on to a single line, current is cut off from one of them, and a signal is given to prevent following vehicles from entering the section. 7 claims.

12,249. "Improvements relating to thermo-electric cells." H. H. Lake. (L. S. Langville, U.S.A.) Dated July 6th, 1900. Relates to thermo-electric batteries, and cannot well be abridged without reference to a drawing. 10 claims.

12,303. "Improvements in or connected with water-tight switch cases." F. Lawley Pinsking and W. H. Walton. Dated July 7th, 1900. A water-tight casing for switches is formed in two parts, with which an ordinary switch is placed. On the top of the casing is fitted a disc, over which a disc may be rotated. The disc is fitted on a spindle, which carries an arm engaging with a lever, which is adapted, when the disc is rotated, to operate the switch lever. 2 claims.

12,321. "An improved collector or commutator for electrical machines." F. Kaoferle. Dated July 7th, 1900. The conducting strips and the insulating strips which separate them are held firmly together in the following manner:—Grooves turned in the ends of the commutator or have insulating rings forced into them, and these insulating rings are, if necessary, strengthened by metal rings. The parts are then clamped between two end discs, of which one is secured to the shaft and the other is movable thereon. The form of the grooves may be modified. 1 claim.

12,331. "Improvements in blocks for electric and like conduits." E. Scheilbach. Dated July 7th, 1900. Relates to sectional multiple conduits for electric and like conductors in which an outer casing is formed of a shell of cement, &c., and is provided with variously shaped grooves, or openings to receive similarly shaped longitudinal tie rods. The interior is filled with lighter material, such as artificial wood, &c., moulded with a number of tubular openings, the ends of the outer casing are arranged to fit together, and the ends of the inner blocks are either flush or fit with sleeves round the tubular openings. 3 claims.

12,386. "Improvements in or relating to mechanical motive devices for the controlling drums or switches of electrically-propelled vehicles." A. J. Boult. Dated July 9th, 1900. Relates to improved actuating mechanism for electric controllers. The mechanism may be fitted in a casing adapted to be placed on the ordinary controller. It comprises a small electrometer, which is started by the handle and drives the controller spindle through differential gearing brought into action by a brake controller by electro-magnets. A spring is fitted in connection with the gearing to return the controller in case of stoppage of the current, or release of the handle. The actuator may be arranged to control a number of motors as on a train. 23 claims.

12,392. "Improvements in clamps for holding the ends of electrical fuses or links acting as electrical conductors." Callender's Cable and Construction Company and J. C. A. Ward. Dated July 9th, 1900. A clamp for holding fuses or conductors is formed with two discs, which are forced together by a spring and an eccentric. In one arrangement the discs are mounted on a central pin to the lower end of which a conductor may be connected. A spring is placed below the lower disc, and a forked eccentric pivoted on a pin, working in a slot in the pin, is arranged above. The appliance is clamped to a suitable base by a nut. In a modified form, the end of the pin being forked, and the eccentric working between the legs of the fork. 3 claims.